

Snakes

No one denies the need to understand the interactions of air, soil, water, Earth's atmosphere, land, oceans, ice and life as a single connected system. We need to do this to really study the Earth as a single connected system. And to be able to do so, we need to appreciate the beauty and importance of every denizen on Earth including the most humble and the most insignificant.

Snakes are perhaps the most misunderstood and therefore, the most maligned creatures on Earth. Human attitude towards this group of animals has been strangely paradoxical. We either worship them or else we kill them on sight. They are one of Life's great treasures themselves, misunderstood, persecuted and now, brought to the brink of extinction by habitats degraded or encroached upon by man. We owe it to ourselves to learn a little bit more about Snakes, our co-inhabitants of Planet Earth and this booklet is a small effort in that direction.

About the author

Sukanya Datta acquired her doctorate in zoology from the University of Calcutta, before joining the Council of Scientific and Industrial Research as a Scientist. She has authored many books (including an encyclopedia of S&T) both singly and jointly with co-authors. She has had a long stint as Associate Editor, Science Reporter-India's premier popular science magazine. She has been actively involved in the popularization of science for the last sixteen years and has many published articles, radio scripts and book reviews to her credit.

ISBN 978-81-7480-163-0

Rs. 65



VIGYAN PRASAR

(Department of Science & Technology, Govt. of India)

A-50, Institutional Area, Sector-62, NOIDA 201307

Phone: 91-120-240 4430,35 Fax: 91-120-2404437

e-mail : info@vigyanprasar.gov.in

Website : <http://www.vigyanprasar.gov.in>



Snakes



Sukanya Datta



Vigyan Prasar

SNAKES



VIGYAN PRASAR

Sukanya Datta

Contents

<i>Foreword</i>	<i>vii</i>
<i>Preface</i>	<i>xi</i>
1. Clearing Myths and Misconceptions	1
2. Snake Ecology and Physiology	27
3. Interesting Trivia	67
Glossary	91

Foreword

Earth is the only planet we know of with life on it. Animals, Plants and microorganisms maintain a delicate balance with a variety of life forms we call Biodiversity. Each species depends on other species for its existence. When we talk of life on earth, we also talk about the human species. If we need to understand and preserve our environment, we shall need to understand the interdependence of the species on each other and the importance of natural resources like air, water and soil for living beings.

Life has continued to evolve on this earth over millions of years adapting to changing environment. Only those species have survived that have adapted to the changing environment. This change could be due to natural causes like earthquakes, eruption of volcanoes, cyclones, and so on. It even could be due to climate change. However, quite often this change is brought about by the species higher up in the ladder of evolution that tries to control environment to suit its needs and for development. This is precisely what human species has done to our fragile planet.

We need energy for development; which we traditionally obtain by burning natural resources like

firewood, coal and petroleum. This is what we have been doing for centuries. Today there is consensus that human activities like burning of fossil fuels and consequent pumping of gases like carbon dioxide into atmosphere have been responsible for the earth getting hotter and hotter. Today, there are threats to our planet arising from climate change, degrading environment, the growing rate of extinction of species, declining availability of fresh water, rivers running dry before they can reach sea, loss of fertile land due to degradation, depleting energy sources, incidence of diseases, challenge of feeding an exponentially growing population, and so on. The human population is now so large that the amount of resources needed to sustain it exceeds what is available. Humanity's environmental demand is much more than the earth's biological capacity. This implies that we are living way beyond our means, consuming much more than what the earth can sustain.

To draw the attention of the world to these aspects and in an attempt to establish that environment is where we live; and development is what we all do in attempting to improve our lot, within that abode, the United Nations has declared the year 2008 as "The Year of the Planet Earth". It is hoped that with the cooperation of all we shall be able to save the biodiversity and the life on this planet. A host of activities and programmes are being organized all over the world for this purpose. One of the important aspects is to make people aware about the challenges we face and the possible solutions to save this planet from heading towards catastrophe. It is with such thoughts that Vigyan Prasar has initiated programmes with activities built around the theme "The Planet Earth". The activities comprise of

development and production of a series of informative booklets, radio and television programmes, and CD-ROMs; and training of resource persons in the country in collaboration with other agencies and organizations.

It is expected that the present series of publications on the theme "The Planet Earth" would be welcomed by science communicators, science clubs, resource persons, and individuals; and inspire them initiate actions to save this fragile abode of ours.

Vinay B. Kamble
Director, Vigyan Prasar
New Delhi

Preface

The General Assembly of the United Nations has unanimously adopted a resolution that was co-signed by 82 nations, to proclaim 2008 as the International Year of Planet Earth (IYPE). This UN year will be the core of a triennium, starting in 2007 and continuing until the end of 2009. It is a joint venture of the International Union of Geological Sciences and former Earth Science Division of UNESCO. The Year's purpose is encapsulated in its strapline "Earth sciences for society." The avowed aim of the International Year of Planet Earth is to demonstrate new and exciting ways in which Earth sciences can help future generations meet the challenges involved in ensuring a safer and more prosperous world.

Earth is the only planet we know to be capable of sustaining life. Even a cursory glance around us shows that the Earth is a complex and dynamic system. No one denies the need to understand the interactions of air, soil, water and living elements—Earth's atmosphere, land, oceans, ice and life— as a single, connected system. We need to do this to really study the Earth as a single connected system. And to be able to do so, we need to appreciate the beauty and importance of every denizen on Earth...including the most humble and the most insignificant.

Snakes are perhaps the most misunderstood and therefore, the most maligned creatures on Earth. Human attitude towards this group of animals has been strangely paradoxical. We either worship them or else we kill them on sight. Most of us are afraid of them though we do hold them in awe too. They move, swim, climb trees and hunt without seeming to miss the limbs they do not have. They strike swiftly and kill silently either by strangulating and suffocating the victim or by means of venom. But in reality they are retiring creatures that would rather flee than confront and stalking humans to extract revenge is not part of their plans. They are not manifestations of semi-divine supernatural beings that sometimes walk the Earth, nor are they guardians of hidden treasure. They are one of Life's great treasures themselves, misunderstood, persecuted and now, brought to the brink of extinction by habitats degraded or encroached upon by man. We owe it to ourselves to learn a little bit more about Snakes, our co-inhabitants of Planet Earth and this booklet is a small effort in that direction.

Sukanya Datta



Clearing Myths and Misconceptions

"Kill the snake!" This very much sums up the common man's plan of action when a snake crosses his path. Irrespective of age, it is a very rare person who does not shudder at the word "snake".

The fear of snakes is not restricted to individuals. In West Bengal the word "*Saap*" is taboo at night. Children are taught to substitute the word "*Lata*" (meaning creeper) when saying "snakes" after sundown. And in case the child has spoken aloud the unmentionable name, he must invoke the Sage Astik to provide protection against the slithering creatures. Such a taboo demonstrates the inherent fear that humans have of snakes.

Sigmund Freud, the famous psychologist, was of the opinion that fear of snakes is a universal human characteristic. Primates other than man, i.e., monkeys and chimpanzees, also have an instinctive fear of snakes. Perhaps this fear is an innate one.

For more than 99 percent of human history, people have lived in groups as hunter-gatherers. In the course of their activities they came into close proximity with other life forms and it was important that they learnt to recognize dangerous animals. There were survival issues then, as there are survival



An Egyptian Painting

issues now. Admittedly though, the nature of our immediate dangers has changed. Neanderthal man need not have feared a speeding car driven by a person high on a cocktail of alcohol and drugs. But he would have to be wary about snakes. We share many genes and genetic traits with our primitive ancestors and therefore still carry genetic traits that led to survival way back then. This has led evolutionary biologist, E. O. Wilson to suggest that the fear of snakes is in our

genes. He suggests that cultural evolution can be linked genetically to biological evolution over time. In simple terms this means that our fear of snakes could be genetically wired. Perhaps in prehistoric days, when people went out to forage in the wilderness, it served to beware of ALL snakes—it would have had great survival value. But even in today's urban milieu where concrete jungles have effectively reduced snakes to a distant memory, people still feel uncomfortable even talking about snakes. To most people the word snake is synonymous with venom. But few people, even educated ones,

stop to ask; "What is this venom that snakes use and are all snakes venomous?" No one asks, "Is this venom "meant" for man?" The answers are surprising ones and snakes emerge as amazing creatures as myths are demolished and the truth unmasked.

stop to ask; "What is this venom that snakes use and are all snakes venomous?" No one asks, "Is this venom "meant" for man?" The answers are surprising ones and snakes emerge as amazing creatures as myths are demolished and the truth unmasked.



A Comic strip showing Lord Shiv with a snake (introducing Strip and spelling may please be Shiv, not Shiva)

The paradox about snakes appears to lie in the way people perceive them. On the one hand they invoke fear and hatred, and on the other, they are worshipped across the world and held in awe and respect.

Almost all ancient civilizations and cultures worshipped the snake in some form or the other. In Australia, the Aboriginal people worshiped a huge python. They referred to it as the Rainbow Serpent and believed it created the landscape,

embodied the spirit of fresh water and punished lawbreakers. Athena, the Greek Goddess of Wisdom is depicted with a shield carrying the image of a snake. The winged staff carried by Asclepius, the Greek God of medicine, has two serpents entwined on it. Ancient Egyptians depicted the Goddess of fertility as a cobra-headed woman. The Egyptians also believed that the snakes were immortal and all Pharaohs had crowns with a cobra figure on it. The Aztecs saw the snakes as teachers of mankind. They worshiped a half-man, half-god incarnation of the Sun god as Quetzalcoatl (meaning plumed serpent).

Vestiges of those practices still survive. The rock pythons are revered across Africa. The Hopi Red Indians consider snakes to be sacred and the emissaries to the Rain Powers. They perform an annual dance with snakes. Afterwards the snakes are returned to their natural environment to spread the word that the Hopi are in harmony with the spiritual and natural world. In India, Lord Vishnu is believed to rest on Shesh Nag, the thousand-headed serpent. Lord Shiv is depicted with cobras around his neck. Cobras are venerated and *Nag Panchami* is a day dedicated to snake worship. Ma Monosha is worshipped in West Bengal as the Goddess of all snakes. Similar deities are revered across India.

Many snakes are identified by name in Hindu mythology and even children know the stories. The snake Vasuki is celebrated for having permitted the Gods and the Asuras to use him as a rope to churn the Ocean of Milk. The venom he spewed is called *Halahal*, and it was potent enough to destroy the Universe, so Lord Shiv contained it in his throat. The venom turned his throat blue—and hence the name Neelkanth (blue-throated) for Lord Shiv. Lord Krishna is sometimes shown dancing on the hood of the snake Kalia. The *Mahabharata* too refers to many incidents involving snakes. There are many other examples from across the world. In Malaysia there is as Snake

Temple where venomous snakes move around freely as devotees offer their prayers. It is a tourist attraction also.

But to scientifically understand one of the most misunderstood of all of Nature's creatures we need to know where it fits into Nature's scheme of things and how exactly its existence enriches the tapestry of life.

Classification of Animals: Basic Facts

To understand all about snakes it is necessary to view it against the backdrop of the biodiversity of which it is a part. No animal exists in a vacuum. The correct identification of any organism is necessary to understand it. It is necessary that its similarities and dissimilarities with all other species be enumerated. Once this is done, it can be given an internationally accepted name that serves as its 'identity tag'.

In the hierarchical system of classification the highest category is the Kingdom. A Kingdom is subdivided into Phyla (Singular: Phylum) based on very distinct and defining characteristics. For example, within the Animal Kingdom, Chordata is a major phylum. Class is a separate category under Phylum. It includes those living beings that are very similar in terms of certain basic features. Organisms of the same Order are more similar than that of the same Class. Organisms grouped in the same Family share a very close similarity with each other. Organisms grouped in the same Genus are even more similar. The Genus is a group of Species more closely related to one another than any other group of Species. The lowest category consists of a single species.

For ordinary purpose the major taxonomic ranks in routine use are:

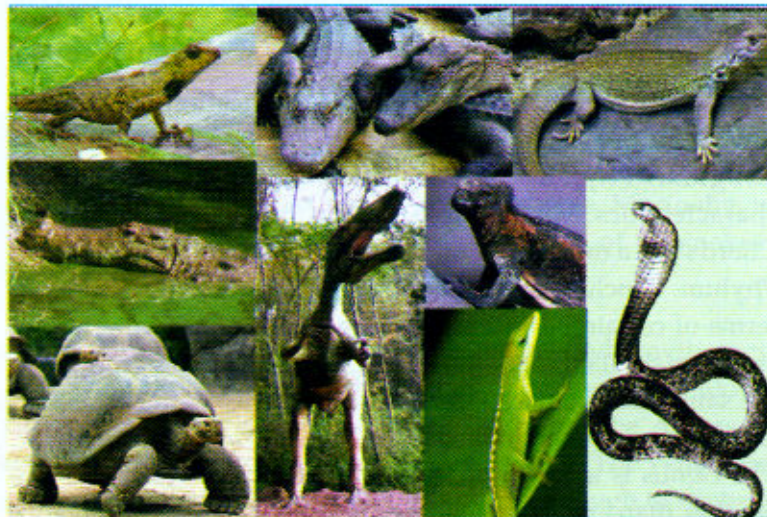
Kingdom
Phylum

Class
Order
Family
Genus
Species

Organisms are named using the binomial system of nomenclature that assigns a two-part name to an organism. These are the genus name and the species name. Both names must be used together to correctly identify an organism.

Snakes and their Relatives

Snakes are vertebrate animals meaning they have a backbone made up of interlocking units called vertebrae. So, snakes



Snakes and their Relatives

belong to *Phylum Vertebrata*, as do all animals that have a backbone. Scientists classify vertebrates into Fish, Amphibians, Reptiles, Birds and Mammals depending on certain characteristics.

Characteristics of Class Reptilia:-

- Reptiles bear scales but not hair or feathers. The scales prevent moisture loss and protect the internal tissues from drying out.
- Unlike amphibians such as the frogs and toads, reptiles never pass through an immature stage involving gills.
- All reptiles are cold-blooded. Scientists call them ectotherms. This means that these animals cannot maintain a steady body temperature and that their internal temperature varies, depending on the environment.
- Reptiles are found almost everywhere on Earth, even in the oceans. They are especially abundant and diverse in the tropics and surprisingly, in deserts. The only impediment that restricts their geographic distribution is their inability to generate their own body heat. Thus no reptiles are found in Antarctica or the polar oceans, it being much too cold in these places.

Snakes possess all the traits that characterize those animals that belong to Class Reptilia. *All snakes are Reptiles.* So are turtles, lizards and crocodiles.

All snakes share certain common features with other reptiles such as turtles, lizards and crocodiles. But they possess certain unique characteristics too. Snakes are quite different from reptiles such as turtles for example, and therefore merit an independent position. Snakes are placed in *Order Squamata* along with lizards but distinct from the Order Crocodilia under which the crocodiles and alligators are grouped and Order Testudines that includes the turtles.

But though snakes appear similar to "legless" lizards, there are subtle differences. Unlike most lizards, snakes have thin, forked tongues, and they lack external ears. Most lizards have movable eyelids but a snake's eyes are always open,

protected by immobile, transparent scales—the reason behind the mesmerising “stare”. Unlike lizards, a snake’s tongue is not used in swallowing prey. So under Order Squamata, scientists have created the *Sub-Order Serpentes* or *Ophidia*, which includes the snakes.

When we look upwards at the arrangement starting from the lowermost rung it becomes clear that similar species are grouped into genera, genera into families, families into orders, orders into classes, classes into phyla, and phyla into kingdoms.

What Sort of an Animal is a Snake?

To a scientist, a snake is merely a member of the Animal Kingdom and one, which possesses a backbone and shares the characteristics of all reptiles. This is how a scientist would identify all snakes:

Kingdom	Animalia
Phylum	Chordata
Sub-Phylum	Vertebrata
Class	Reptilia
Order	Squamata
Suborder	Serpentes/Ophidia

Are all Snakes Venomous?

Not all snakes are venomous. Of the approximately 2600 species of snakes known, only 450 or so are venomous. And of all the venomous species known, only about 270 species have venom that can be fatal to humans. And of these, only about 25 species cause the most number of deaths.

Most of these venomous snakes are not dangerous to humans because their venom is either too mild or injected in too small a quantity to be fatal. Sometimes the snake’s mouth

is too small to bite a human; or its mouthparts too weak to break human skin; or its teeth are placed too far back in the mouth to inflict major damage.

Only four families of snakes are dangerous to humans. But just because a snake is venomous does not mean it is related to another venomous species or that all venoms act in the same way.

Venomous snakes are generally classified into:

- Family Elapidae: It includes the Elapids such as cobras, king cobras, kraits, mambas, copperheads, and coral snakes.
- Family Viperidae: It includes the Viperids such as vipers, rattlesnakes, copperheads/cottonmouths, adders and bushmasters.
- Family Colubridae: It includes the Colubrids such as boomslangs, tree snakes, vine snakes, mangrove snakes etc. (However, not all colubrids are venomous).
- Family Hydrophiidae (or Hydrophids): It includes all sea snakes.

Action of Poisons

Elapid snakes: The venoms affect the nervous system causing paralysis. Venoms from African and some Asian cobras can cause marked swelling, blistering and damage to the skin near the bite. Venoms from kraits, mambas, and coral snakes cause swelling but no local skin damage.

Viperid snakes: The venoms affect the blood, the heart, and the circulation. Usually the venom also causes severe damage to the skin and muscles near the bite.

Colubrid snakes: The venom affects the blood.

Hydrophid snakes: The venoms affect the nervous system and cause paralysis.

Fearsome Fangs

All venomous snakes share a common trait. They deliver the venom through a pair of specialized teeth called fangs. The fangs are connected to the venom producing glands by narrow tubes through which the venom reaches them. Depending on the species, the fangs are located at the back of the mouth or the front.



Fearsome Fangs

There are two types of fangs. These are:

Grooved fangs: These fangs have a groove through which the venom runs.

Hollow fangs: The hollow-fangs are like a hypodermic needle through which the venom flows.

Hollow fangs are of two types:

- **Erectile:** The erectile teeth are retracted into a groove on the roof of the mouth and extend when the mouth opens to strike. Viper fangs are examples of such large fangs that are folded back when not in use.
- **Fixed:** These fangs always remain extended. Such fangs are necessarily short or else the snake runs the risk of accidentally puncturing the inside of its mouth with its own fangs. A snake is not protected against its own venom and would therefore succumb to it. King cobra fangs are a good example of short and fixed fangs located towards the front of the mouth.

Irrespective of the fangs being erectile or fixed, the two puncture wounds on the site of the bite by a venomous snake are courtesy the two fangs. Sometimes there may be only one deep puncture especially if the bite is on the tips of the finger or toes. This happens when the target area is too small and the second fang has missed making contact.

Strange Saliva

Snake venom is modified snake saliva! Composition wise, it is complex-protein in nature. Well over 30 chemical components have been identified in venom. Most of the proteins are enzymes. Technically speaking therefore, ingesting snake venom ought not to kill a person. Our protein-digesting enzymes would simply get to work at breaking down or denaturing the venom and digesting it. However, it is not recommended that we put our digestive enzymes to the test because an open wound or a cut in the mouth or an ulcer anywhere in the digestive tract would allow the venom to enter the bloodstream and perhaps even endanger life.

Scientists have devoted much thought to why and how such a sophisticated poison apparatus and delivery mechanism

(fangs) developed. Most think that the early snake ancestor had some sort of toxic saliva. Toxic saliva would have conferred advantages to the predatory animal. Once in contact with the saliva, the struggling prey would become still for ever, allowing for peaceful ingestion. Over time, the venom apparatus and the fangs developed to reach the perfection we see today.

Mechanism of Venom Action

Snakes use venom to immobilize or kill prey. Many snakes have venom that is not harmful to humans. Others have a venom reservoir equipped to kill humans from the moment they emerge from their eggshells; although no snake deliberately seeks out human beings to kill.

Snake venom can be either a neuro-toxin meaning that it attacks the nervous system or it can be a hemo-toxin, meaning it attacks the circulatory system. Neuro-toxic venom particularly affects the brain-centres that control breathing and heartbeat. Thus the victim has difficulty breathing and swallowing. Hemo-toxic venom destroys red blood corpuscles and breaks down body tissues such as blood capillaries. Hemo-toxins usually cause internal bleeding in human victims. Death occurs due to shock. Spitting cobras can “spit” venom - with deadly accuracy - into their victim’s eyes. Sea snakes have an unusual type of venom. It affects muscles.

Dry Bites

Venomous snakes can also bite without injecting venom. These bites are called “dry-bites.” Approximately 20-30 percent of defensive strikes are “dry-bites.” This has led to the common belief that snakes can “choose” to control venom injection. Some scientists believe that snakes do not like to waste their venom on anything other than prey. A strike with injection of a minimal quantity of venom (or none) is equally effective at

temporarily warding off large animals, as is a large supply of venom. This has the added advantage of conserving venom—a precious resource. However, why snakes “dry-bite” when they feel threatened and are striking out in self-defence, has still not been satisfactorily explained.

Knowledge about “dry-bites” may have a practical benefit in the context of human victims. Most panic-stricken victims thrash around in pain and fear. This helps the venom to spread rapidly in the body. If the general public is educated about “dry-bites”, it may improve the chances of survival for a snakebite victim who would otherwise have panicked. On the flip side, the same knowledge may cause a person to presume the bite is a “dry-bite” and delay seeking medical help.

Romulus Whitaker, noted snake expert and the survivor of a dry-bite, has confirmed in an interview given to *The Hindu* (2004) that a snake can inject the quantity of venom it wants and that it is an entirely voluntary process. He said, *“This I learnt doing thousands of venom extractions. Sometimes the snake will not give any venom at all. But you never know how much venom was injected into you except by the progress of the symptoms”*.

“Dry-bite” or not, all snakebites must be treated by qualified medical personnel. We must not presume that a bite is a dry one and always bear in mind that even a dry-bite may become infected.

How to Avoid Being Bitten

1) Act Sensibly

We must exercise caution and be alert when walking through snake territory characterised by tall grass and thick vegetation. We must also remain alert in desert terrain and while climbing rocks and trees, especially at night. Boots, socks and long

trousers can provide protection. Farmers, plantation workers, and fishermen in rural areas of the tropical countries are particularly at risk, as well as children running about barefoot or paddling in ponds. They must be careful while they go about their business.

Snakes like to sunbathe on tops of rocks and climbers must beware before reaching out for overhanging ledges etc., while rock-climbing. Climbers must also avoid exploring crevices etc., with their fingers. It is always unsafe to introduce hands or toes in places not first visually examined.

If the area has been flooded and floodwaters have entered your house, it is likely that snakes and other animals have been displaced from their homes too. They may enter human habitats in search of shelter and while following food such as fleeing rodents.

2) Understand Nature

A snake's colouration helps camouflage it in its normal habitat. It breaks up the snake's outline and makes it blend in with the background. So it is not easy to spot snakes, especially in the dark. More face-to-face hostile encounters do not occur because snakes are shy creatures that prefer to run away rather than confront humans. But dwindling home range because of habitat destruction are forcing snakes to come into contact with humans.

Food sources, such as mice and rats, attract snakes. Farms and fields, where mice and rats abound, are the places where we may expect to encounter snakes. Snakes, like most animals, are most likely to bite when they feel threatened, are startled, provoked, and/or have no means of escape when cornered. Usually a person is bitten either when holding a snake or

attempting to pick it up or to kill it. But biting a human is never top-priority for any snake. Rather, many play trick to make the aggressor drop it and move away.

Some snakes, such as the hognose snake (*Heterodon platyrhinos*), pretend to be dead to fool their enemies. This snake pretends to die by flipping over on its back and wiggling. It may bleed at the mouth, regurgitate food or hang out its tongue.

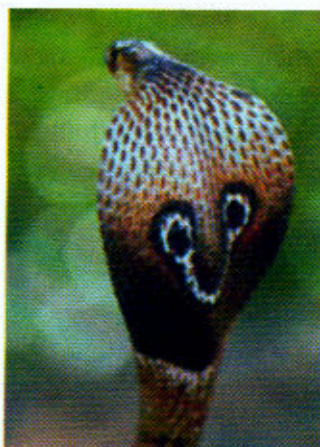


Hognose Snake

If you pick it up and place it right side up, it will roll over onto its back again to continue playing dead! And it won't "come alive" till it feels safe to do so. The Asian tentacled snake (*Erpeton tentaculum*) pretends to be dead by holding its body as straight and stiff as a stick. But this does not mean these snakes will not bite if the limits of their tolerance are passed. It is better to slowly walk away from any snake, even an apparently dead one. Avoiding bites is much easier than treating them.

3) Pay Heed to Signals

Some snakes such as the rattlesnake make warning sounds by jerking the “rattle” at the end of their tails. The hognose snake



Naja naja

hisses to frighten off predators. It flattens its neck like a cobra and makes short darting movements with its mouth closed. Then it starts writhing and opens its mouth very wide. When frightened, the parrot snake (*Leptophis ahaetulla*) attempts to frighten its enemies by raising the anterior part of body, opening its coloured mouth and hissing. If the threat persists it inflates its neck region. The spectacled cobra (*Naja naja*) raises the front one third of its body off the ground and

suddenly spreads its hood. It hisses in annoyance and can “spit” venom. When threatened, the kingsnake (*Lampropeltis getulus*) hisses, and vibrates its tail. When attacked it rolls into a ball with its head in the centre. It then smears its attackers with foul-smelling exudates from its cloaca. The king cobra (*Ophiophagus hannah*) can stand up to one third of its total length...and look an adult in the eye and does so in warning. It can even move forward in the intimidating pose. But an upright posture without the hood extended is non-intimidating in nature and the snake often assumes this pose to see over tall bushes etc. Some snakes



King Cobra

lunge at attackers. Mambas and cottonmouths display their fangs. Most venomous snakes make a few false strikes before actually biting.

These are all signals that the snake is either annoyed/feeling threatened or issuing a warning. It is always better to back off and also to allow space for the snake to retreat.

Snakebite Facts

In India alone 15 000 people of the about 20 000 bitten by snakes die every year. Those bitten are mostly rural people, construction labourers, and farmers working in fields or those sleeping outdoors. The exposed parts of the body, mainly the

Early Signs of Poisoning

There are no “standard signs” but the following symptoms may manifest within 15 minutes after the bite or be delayed for up to 10 hours. The degree of manifestation depends on the species that bit the victim; the physiology of the snake and also the physiology of the individual.

- Redness and swelling around the bite
- Severe pain at the site of the bite
- Dizziness, nausea and vomiting
- Laboured breathing (in extreme cases, breathing may stop altogether)
- Disturbed/blurred vision
- Increased salivation and sweating
- Numbness or tingling around the face and/or limbs
- Paralysis of the muscles in the face, lips, tongue and throat, causing slurred speech, drooping eyelids, difficulty in swallowing,
- Muscle weakness,
- Lips and tongue turn blue

hands and feet are the sites bitten in most cases. Most cases of snakebite occur during the monsoon season because of flooding of the snake's habitat and those of its prey. More snakebites occur at night.

What To Do If Bitten.

If bitten or if witness to a snake bite: **DO NOT PANIC.**

Remember, death following snakebite is not necessarily the same as death due to snakebite.

Some Do's

- Realize the victim needs to be taken to a hospital.
- Lay the victim flat. Keep him calm.
- Check if there are two deep puncture marks (fang marks) on the site of the bite. There may be pinprick-like marks along with the two deep wounds.
- In case of multiple pinprick-like puncture marks (like an inverted U), it is likely to be the bite of a non-poisonous snake. Clean the wound site and take the patient to a hospital. An anti-tetanus shot may be needed.
- Take off the patient's rings, bracelets, anklets and shoes as swollen limbs may lead to constriction of blood flow at these points.
- Put a splint on the limb so that the patient cannot bend it.
- If the patient is unconscious or drowsy, check breathing every 10 minutes, and keep him warm.

Antivenin should only be given in a hospital/medical centre where resuscitation facilities are available if the patient has an allergic reaction to it.

It is important to take ALL victims of snakebite to a hospital.

Some Don'ts

- Do not try to catch the snake. This may increase the number of those with snake bites.
- DO NOT waste time trying folk remedies. Time is of the essence.
- Do not let the patient thrash about in fear and panic.
- Do not give aspirin for pain relief. It may lead to more bleeding.
- Do not try to suck out the poison. If you have cuts or ulcers in the mouth you may end up with the poison entering your system and there will be two patients, not one.
- Do not open the puncture site with a knife.
- Do not apply an arterial tourniquet or too tight a bandage over the bite.
- Do not allow the victim to drink alcohol/cafeinated drinks.

If possible describe the snake, so the doctor will know which anti-venom to use. Treatment for snakebite is available free in all Delhi Government hospitals.

What is Anti-venom?

Anti-venom is nature's protection against snake venom and man has learnt to make and use it to counter snakebite. Antivenins bind to and neutralize the venom, halting further damage, but do not reverse damage already done. Thus, they should be administered as soon as possible after the venom has been injected. Antivenins are called monovalent when they are effective against a given species' venom or polyvalent when they are effective against several different species.

Antivenins are made by injecting minute quantities of snake venom into a horse or sheep and gradually increasing

the dose. Since snake venom is a protein, the body treats it like an **allergen** and develops **antibodies** to the venom. These antibodies circulate in the blood and offer a sort of “**immunity**” to the venom. Once a sufficiently high titre of antibodies is reached, the animal’s blood is extracted and the antibodies concentrated and freeze-dried for storage. Because each snake species’ venom is unique, different anti-venom is developed for each snake.

The principle underlying the use of antivenin is based on that of **vaccination**. However instead of inducing immunity in the patient directly, it is induced in a host animal first and then transfused into the patient. Albert Calmette, a French scientist at the Pasteur Institute developed the first antivenin for snakes (called an anti-ophidic serum) in 1895. It was developed against the Indian cobra (*Naja naja*).

Milking a Snake



Venom extraction

Milking a snake is NOT the same as milking a cow. For one, a snake has no udders and produces no milk. Secondly milk is a wholesome food; poison is not. An expert snake handler “milks” the poison apparatus of the snake and collects the venom in a clean glass vial with a stretched membrane covering it. The snake is induced to bite through the thin membrane and the “bite” makes the venom flow. It is collected in the vial. Fresh venom is clear, viscous liquid and yellowish in colour. The extracted venom is purified,

the dose. Since snake venom is a protein, the body treats it like an **allergen** and develops **antibodies** to the venom. These antibodies circulate in the blood and offer a sort of “**immunity**” to the venom. Once a sufficiently high titre of antibodies is reached, the animal’s blood is extracted and the antibodies concentrated and freeze-dried for storage. Because each snake species’ venom is unique, different anti-venom is developed for each snake.

frozen and then freeze-dried to make the pure venom powder that is used by laboratories for producing anti-venom serum.

Demonstration of the process can be seen at snake parks -notably at the one in Chennai.

Immunity to Snake Poison?

No animal is naturally “immune” to snake poison but those species that eat snakes are often resistant to the venom of their prey. They are able to tolerate large doses of the venom without ill effect. But they are also not resistant to the venom of other snake species. The mongoose that often kills the cobra in a fight will die if the cobra gets its fangs into it. So the nimble-footed mongoose relies on its swift responses to keep out of the way of a cobra bite while tiring out its opponent.

Demolishing Superstition

Ichchadhari Nagin

This is a myth from India. *Ichchadahari* snakes (*Naag* for the male and *Nagin* for the female) are supposedly celestial creatures that can take on human forms once in a while. Quite a few blockbuster movies have been made on this theme. Suffice to say that though the tales are creative enough and deserve appreciation, there is no scientific fact or truth behind them.



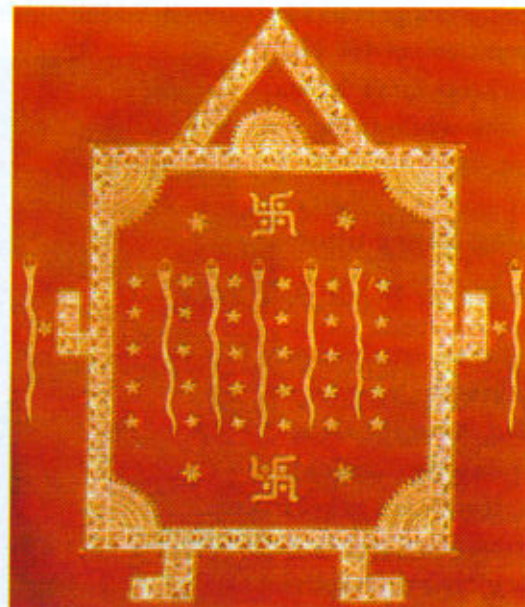
A film poster based on myth of *Ichchadhari* Snake

Naag mani

Certain snakes, particularly cobras are believed to bear a gem on their hoods. The gem is supposedly a luminous one and it is believed that it lights up the area around it. There is no truth in the story though lots of charming fairytales have been spun around this concept.

Guardian of Hidden Treasure

Hidden treasure is almost by definition, buried treasure. In Indian stories, the treasure is usually hidden in earthenware



Snake in Indian folk painting

pots (*matka*), its mouth covered with a cloth and buried in a forest. With time, the cloth covering the pot would no doubt decay and rains wash away the layer of soil covering the pot...to reveal a lovely home for a snake looking for a place to

hide. It is easy to see how the myth of a serpent guardian of gold and gems would be perpetuated if some lucky human stumbled onto this rich find. But the fact remains that snakes have no need of gold and have never displayed any avarice for it.

Revenge of the Snakes

It is popularly believed that the image of its killer remains as a photograph in the eyes of the snake that has been killed. Its mate then seeks out the killer and bites him in revenge. This belief has no scientific basis to it. Vision in animals (and humans) does not use film as a camera does. It is, in a way, an entirely chemical reaction interpreted by the brain. Once the animal is dead there is no "residual or etched" image that can be seen by others.

The belief that the survivor of the pair will seek revenge if one is killed is also a myth. Snakes do not form social bonds and do not "feel" vengeful. Perhaps the myth arose in an area rich in a certain species of snakes and where the reptiles crossed human paths rather too often for their own good. However, the myth has protective value for snakes, as it only during mating seasons that male snakes follow females. So if the fear of retribution stays even one human hand from killing just one snake, it would mean a small boost for dwindling biodiversity.

Burning Dead Snakes Confounds the Mate

In India it is believed that a snake that has been killed must be burnt to remove all evidence of its death. Otherwise its mate will track down its body and extract revenge.

The truth is that snakes do not form bonds. Fidelity in snakes is unknown; the pair parts company soon after mating. However, the myth has, at least one, good fallout. The venom

in the gland of a dead snake is still potent and involuntary muscle spasms can still inflict bites especially if the body is handled carelessly or in a spirit of bravado.

Snakes Chase People

Herpetologists or scientists who study snakes never complain about being chased by snakes. This is perhaps because they know that snakes are shy creatures that are most probably trying to escape the confrontation that has arisen. Other people are apt to panic. They run helter-skelter. Given the fact that snakes seem to slither along and not walk in a straight line a person fleeing the snake and looking over his shoulder in panic would no doubt think the snake was chasing him. Snakes only follow prey species and humans do not qualify as one. No snake would waste energy chasing something it cannot eat and snakes have, till date, never demonstrated the emotion of hatred or vengeance.

Snake Stones Suck Out Poison

There are no such things as snake stones and even if snakecharmers produce one, it is should NOT be used to treat any snakebite.

Folkcure for Snakebites

Snake charmers often produce herbs they claim can treat snakebite. In rural areas shamans mutter incantations, burn smoke-emitting chemicals and sometimes beat the victim to rid the patient of poison. They say they can make the snake come back and suck its poison out. There may even be those who may claim to have



A poster showing Indian Myths relating to snakes

“recovered” from snakebite thanks to these practices. This is nonsense. Snakes cannot be called back from the wild and snakes cannot suck out the poison once it has been injected—they do not have sucking mouth parts. The most plausible explanation for the “recovery” is that most snakebites are bites from non-poisonous snakes and all these so called treatment merely provides a diversion from panic that the victim would have felt had nothing been done. All the posturing and chanting may look interesting in movies, but in real life, it is a waste of precious time and may spell the difference between life and death.

It can never be reiterated often enough that, *ALL snakebite victims should be taken to a hospital.*

Snakes Drink Milk

Snakes are reptiles. Milk is a drink Nature has provided for mammals. Reptiles do not naturally drink milk. The snakes used for worship on *Nag Panchami* day are usually caught many days in advance and not given anything to eat or drink. The snake therefore drinks the milk placed before it in an attempt to assuage thirst.



Snakes do not drink milk

Snakebite Addiction

Occasionally it is reported in newspapers that some persons can withstand repeated bites by venomous snake. There are sporadic rumours that some take these bites as a

means of intoxication. There is at least one research paper documenting two cases in which snake venom intoxication as a habit was associated with addiction to heroin, cannabis and



Snakes in Indian Temple

mandrax (methaqualone and diphenhydramine). The users agreed that bites on the tongue were quicker to produce effect as compared to bites on the toes. Apparently "snake-dens" operate across the country but a shroud of secrecy envelopes the activity.



Snake Ecology and Physiology

Snakes exhibit many peculiarities that endear them to the serious students of zoology. If nothing else, their elongated and flexible bodies exemplify just how versatile Nature can be in fashioning lifeforms superbly adapted to the terrain they inhabit. They also play a very important role in Nature by keeping a check on vermin. Ecologists therefore never tire while extolling the role of snakes as Nature's great balance-keepers.

Habits

Snakes are not social animals and have never been seen to live in communities. They are not easy to train and therefore scientists find it difficult to carry out studies on them to determine behaviour. In the few experiments that have been carried out, snakes have demonstrated very little learning ability.

As with most reptiles, there is tremendous pressure on snakes to "grow up quickly". The young are born as miniature adults and are independent almost immediately thereafter.

There is no leisure to acquire behavioural or social skills during playful interaction with peers. Thus the young are "precocious." Newly born snakes are competent at carrying out the tasks the first time they encounter the task. This lack of "play" is a major differentiating point between reptiles and mammals.

It is difficult to mark wild snakes so as to identify them with certainty scientists are not sure if snakes have "territory" they regard as their own in the wild. Most snakes do not appear to actively defend their territory. Females that defend their nests are not considered "territorial." Rather they demonstrate defensive behaviour to protect their eggs. A study has shown that male prairie rattlesnakes restrict themselves to an area a little over a kilometre while females roamed over a lesser area of only 0.27 kilometres.

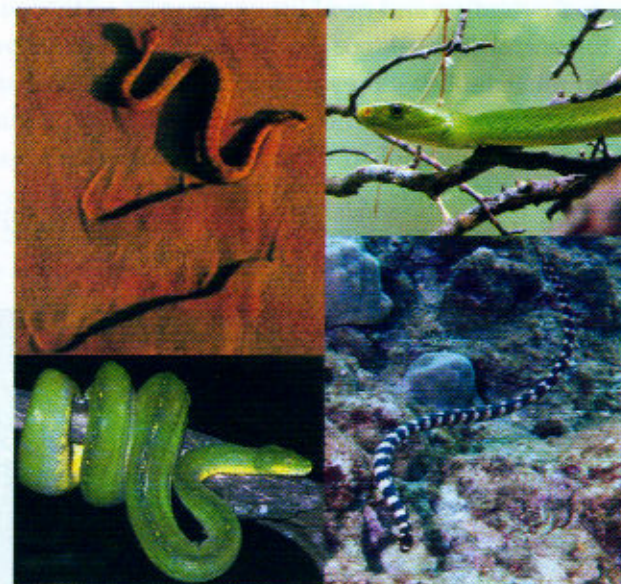
Homing or the ability to return to the original spot from which they came has been experimentally demonstrated in some snakes. It is believed that the snakes took their navigational cues from the Sun. However, the homing ability was not demonstrated in other studies. Some scientist feel that this is perhaps because the animals "assess" the new habitat before they "decide" whether to return to the old home or adapt to the new one. Sea snakes have been reported to have stronger homing abilities and apparently can navigate back to if translocated.

Snakes do not make the best of pets because they are difficult to train and do not return affection. Many like to stay hidden and are difficult to feed in captivity. Some are easily provoked and may bite the owner—not a pleasant experience.

Habitat

Snakes are at home in almost all sorts of habitats. They are found in deserts, forests, rivers, ponds, and oceans. They are

found in trees, on ground and below the soil surface. Only icy wasteland or permanently frozen grounds have defeated colonization by snakes. The Polar regions are bereft of snakes and the frozen summits of high mountains are snake-free too.



Snakes are found in almost all sorts of habitats

Isolated islands remain snake-free till snakes are accidentally or deliberately introduced. Once that happens, the snakes flourish as they do everywhere else. Ireland and New Zealand are examples of snake-free islands. But fossil finds in 2002 have proved that New Zealand did have snakes some 15 to 20 million years ago during the geological time period known as the Miocene age.

Introducing snakes into a snake-free area may lead to loss of **endemic** wildlife. The brown tree snake (*Boiga irregularis*) was accidentally introduced to the till-then snake-free Pacific island of Guam in around the end of World War II. Since then

it has decimated the island's endemic birds and reptiles. As in the case in Guam, **exotic** species are usually accidentally introduced into areas where their natural enemies are absent. The local population often do not have the necessary adaptations that would have protected them...such adaptations are a part of evolution and need time to manifest. Without any species to control and balance their spread, the exotic species' flourish to the extent that they upset the balance of nature.

Body Shapes

It is amazing to see the variety that Nature has managed to endow on what is essentially merely an elongated tube.



Anaconda which can be 9 meter long and weigh up to 500 kgs

Males and female snakes do not vary greatly in body shape though females may be larger than males in some species. The tree-dwelling Madagascar leaf-nosed snake (*Langaha madagascariensis*), however, is an exception. The males have a pointed snout and contrasting body colour, while the dark brownish females have a maple leaf-shaped snout.

Aquatic snakes usually have flattened bodies. Sea snakes have laterally flattened bodies and the tails form an oar-like paddle. Those living in trees are usually long and slender and have tails they can use to hang on with. Burrowing snakes tend to be compactly constructed. Snakes such as the land-dwelling gaboon viper (*Bitis gabonica*) have a stout body. It is usually lethargic in nature though it can strike swiftly and with deadly effect. On the other hand, the yellow-faced whip snake (*Demansia psammophis*) is a slender and fast-moving snake. The slender vine snakes may be 1.5 m long but are so light that they can extend half of their bodies into midair when crossing from branch to branch. An anaconda 9 meters long can weigh up to about 500 kg. The sheer physical bulk of the anaconda has made it a creature looked upon with distrust by humans who falsely accuse it of having a taste for human flesh.

Slimy? No Just Scaly

There is a popular misconception that snakes are slimy to touch. Cold they may feel, but snakes are not slimy. Like the skin of



Closeup of Snake skin showing scale pattern

all reptiles, snake skin is covered by scales. These scales are made up of a horny material called keratin—the same material that makes up our hair. Scales may be smooth or have a ridge over the centre. In the latter case, the scale is said to be keeled.

Some snakes have small scales; some have larger ones. Their eyelids are transparent “spectacle” scales called brille. The top of the head may have large scales called head shields. Similarly the large scales on the underside of the head are called chin shields. The big, strap-like scales on the belly are called scutes. Most snakes use the specialized belly scales to grip surfaces as they move. The scales on the body of the snake are called the dorsal or costal scales. Sometimes there is a special row of large scales along the top of the back of the snake, i.e., the uppermost row, called the vertebral scales. The enlarged scales on the belly of the snake are called ventral scales or gastrosteges. The anal plate protects the opening to the cloaca.

The eyelash bush viper, (*Atheris ceratophora*) gets its name from the set of horn-like scales above each eye. This is an example of scales modified to form fringes.

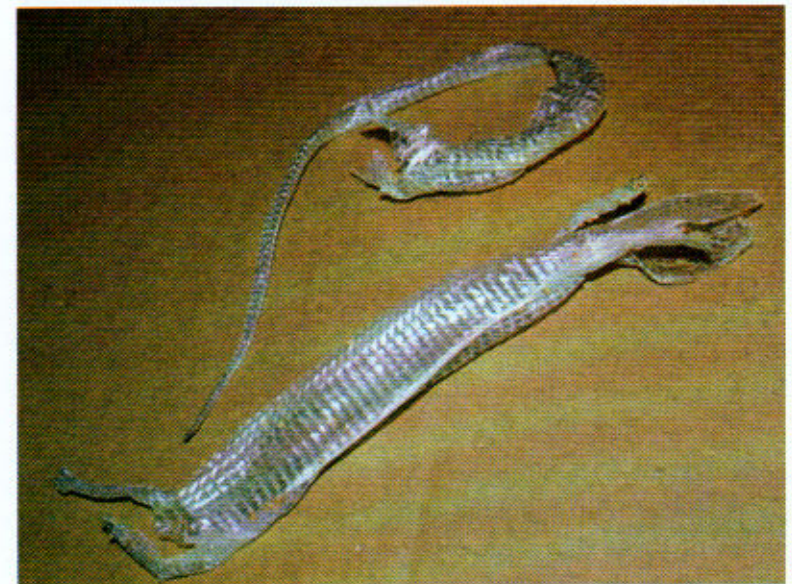
Colouration

Scales have tiny bodies called chromatophores that lend it colour. Some chromatophores contain pigments (usually blacks and browns). Other chromatophores act like tiny prisms and break up light into its constituent colours. Most snakes are drably coloured in earth-tones to blend with their natural surroundings as they slither over the grounds. A king cobra’s colour varies from olive-brown to gray and even to a deep, shiny black. In general, those living in dark forests are darker in colour, and those that inhabit open forest or plains have lighter colours. However, tree-dwelling snakes are usually green in colour. The reason is the same. The green colour helps them to blend in with their surroundings. Some snakes, such

as coral snakes, have brilliant yellow and orange stripes that warn predators of their venomous bite. And certain non-venomous snakes **mimic** these vibrant colours to mislead potential predators into mistaking them for their venomous counterparts.

Shedding Skin

The scaly skin of a snake has two layers. The inner layer of skin consists of cells that grow and divide. The cells die as



Snake shed their skin periodically

they are pushed upwards by the cells from below. The dead cells form the outer layer of skin. Snakes apparently keep on growing throughout their lives although the rate may slow down in old age. Because their bodies are encased in scales they need to slough or shed their skin periodically. The primary purpose of shedding skin is to grow. Imagine a coat that is now too tight and no longer comfortable because you have

grown. You too would remove it. When a snake does this, there is a new and better-fitting coat beneath the sloughed skin. Shedding also removes external parasites such as ticks.

The eyes of the snake become cloudy a few days before molting and the snake's colour also appears to be dull. Then the eyes become clear again and the cuticle begins to peel from the sides of the lips. The snake accelerates the process by rubbing its nose against something rough. This creates a rip around the nose and the mouth and as the snake writhes and rubs against the rough surface it sort of peels off, inside out. The skin is shed in one piece, rather like pulling off a sock. The discarded skin of snakes often indicates its size.

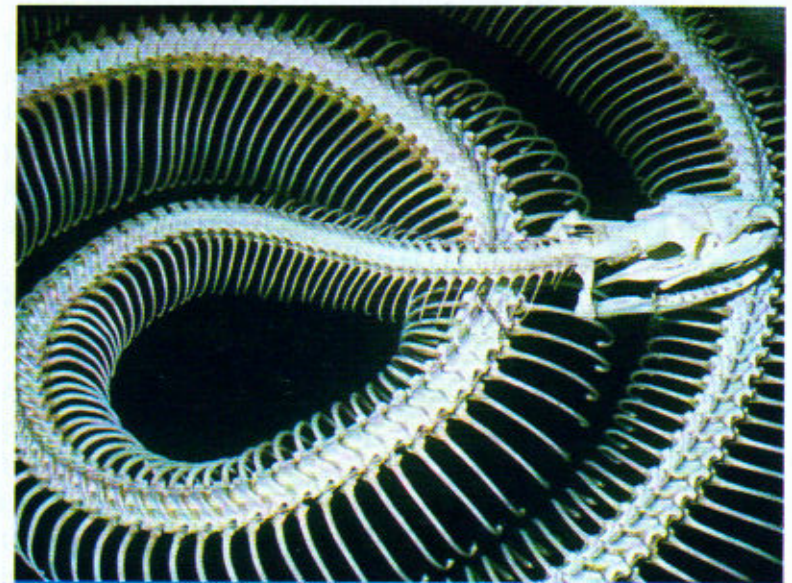
A snake sheds its skin several times a year. Young and rapidly-growing individuals shed their skins more frequently than the mature specimens. Those that live in warm climates and are more active as a result, molt more frequently than those that live in cooler place.

It is the process of sloughing that gives rattlesnakes their distinctive rattles that grow with each molt. The rattlesnake tail tip is blunt and bears a thickened horny covering with constrictions. When the molt occurs, this horny tip is held back by the new tip growing beneath it. Successive molts result in a series of these dry segments being formed and this is what gives rise to the "rattles".

Shedding is not without potential problems. If the weather is too dry while snakes are shedding their skin, the dry skin does not shed properly. An incompletely sloughed tail tip can constrict as the snake grows, cutting off the blood supply to the end of the tail causing it to drop off. If the spectacle-scale that normally covers the eye is not properly shed, it can cause the snake to become blind in that eye.

Snake Skeletons and Musculature

Snake skeletons are relatively simple because snakes do not have limbs. All other snakes (apart from boas and pythons) simply have a skull, many vertebrae and some ribs. Snakes have an unusually large number of vertebrae—between 130-500 vertebrae—depending on the species. Twenty-four small muscles are attached to each vertebra and rib. The muscles



Skeleton of a snake showing skull, vertebrae and ribs

connect; one vertebra to the other, the vertebrae to the ribs; one rib to the other and the ribs to the scales. The strong and flexible joints that connect the vertebrae are responsible for the tremendous flexibility that snake's have. Without such joints the snakes would not have been able to coil into a ball or execute the writhing movements that they make so effortlessly. In fast-moving snakes, the locomotor muscles are elongated and span many vertebrae and form arcs during

undulating movements. The muscles are lightweight as they consist mostly of tendons rather than muscle tissue itself. In snakes that constrict their prey, the muscles are heavier and shorter and have great constriction-strength albeit making for slower locomotion.

A pair of ribs is attached to all vertebrae that arise before the tail section. In other words, the bones in the tail section do not bear ribs. The ribs are not joined to form a rigid ribcage. Instead they can be extended outwards so that they may accommodate the bulge in the stomach after a meal.

The joint of the upper and lower jaws is placed very far back in the skull. This allows the mouth to open very wide. Also, the bones of the lower jaw are not fused together at the front, which means, they can move sideways (laterally) when the snake is swallowing large prey. In addition, there is an additional loosely-attached bone called "quadrate" on each side. This provides a "double hinge" at the joint again, allows extra flexibility to the jaws.

Vision

Snakes have an eye on each side of the head so that their field of vision is extended. Their eyes have no lids and do not close. Most snakes can see very well and all snakes can detect motion. Arboreal or tree-dwelling snakes have the best vision and burrowing species have the worst. In most snakes, the lens moves back and forth within the eyeball to focus. Those snakes that hunt during the day have rounded pupils while nocturnal snakes have vertical pupils somewhat like cats.

In addition to their eyes, some snakes have infrared-sensitive receptors in deep grooves between the nostril and eye. These allow them to "see" the radiated heat. A snake with pit organs is sensitive to a temperature difference of less than 0.5° C.

Pit vipers find prey using these pits to detect the body heat given off by prey. Using this extraordinary heat-seeking ability, pit vipers can even track down and kill prey animals in utter darkness.

Sense of Hearing

"Deaf as an adder", they say and there is good reason to say so. Adders are snakes and like all snakes they have no external ears. Like all snakes adders are stone deaf. Because they cannot pick up air-borne vibrations snakes are deaf to air-borne sounds. But some bones in their head are modified such that they are extremely sensitive to vibrations in the ground. The part of the body that is in direct contact with the surface of the ground senses vibration, and a snake is able to sense other animals approaching.

Sense of Smell

"Speaking with a forked tongue", is what we say when we accuse someone of duplicity. This is just one example of our prejudices about snakes. But then, snakes do have forked tongues. They also have a notch on the upper lip so the tongue can flick in and out while the mouth remains closed. The forked tongues that flicker in and out of their mouths serve an important purpose. A snake smells by using its forked tongue. It collects airborne particles and then passes them to the Jacobson's organ or the Vomeronasal organ in the roof of the mouth for examination. The organ analyses the chemical composition of the molecules present in the air and the message is relayed to the brain.

The fork in the tongue allows the snake to "differentiate" or compare the sensations received by the two ends of the tongue. This gives the snake a sort of "stereo or directional sense" of smell. Once it knows at which end of the fork the

sensation is richer, it automatically knows which way it must go to follow the prey, even in utter darkness, and when to strike. The basic principle behind humans having two ears is the same...it allows us to know which side the sounds has come from. The tongue also doubles as touch-sensing organ and is used to delicately probe the surroundings. Interestingly, snake tongues appear to have no tastebuds.

Locomotion and Swimming

Snakes move in four different ways. To a viewer all appear equally graceful and exceptionally fascinating since these animals lack limbs. They also appear to move very swiftly. But this apparent swift movement is possibly panic-fuelled faulty judgement on our part. Snakes do not move more than 5-6 km an hour and this speed too cannot be sustained over extended periods.

Serpentine or Lateral Progression: This form of locomotion is the undulating crawl, commonly called 'slithering,' and the most common form of movement. It allows the snake to reach maximum speeds and is employed by all water snakes to swim.

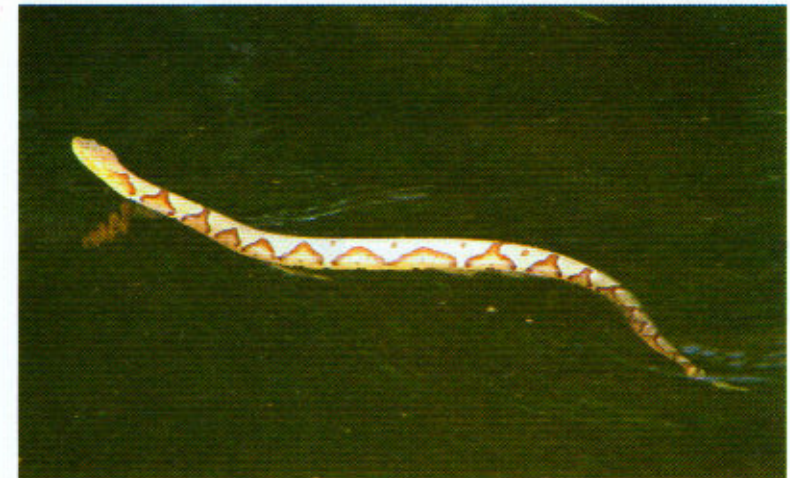
Rectilinear or Caterpillar Movement: Large, heavy snakes also use caterpillar-like movement to travel in a straight line. They are able to move the scutes forward using powerful muscles and then pull the rest of the body along. The scutes come in useful while climbing trees too.

Sidewinding: As the snake moves, its body contacts the ground only at certain points at any given moment. Each part of the body flows through an S-shaped curve above the ground as the body is transferred from one of these contact points to the next. Snakes that live in deserts on loose sand use this type of locomotion to manoeuvre easily over flat, low-friction, sandy terrain.

A variation of sidewinding, called saltation, occurs when the body is straightened so strongly and rapidly that it lifts completely off the ground. It is a rapid escape- movement.

Concertina: Some snakes apply the concertina technique when climbing trees. The body bunches up forming horizontal loops and then the head moves forward and the body straightens, similar to an accordion or spring.

Apart from these movements, snakes can "parachute" from tree to tree or from one branch to another. Some snakes also seem to "jump", particularly when fleeing.



Snakes are good swimmers

Swimming

Snakes seem to have taken good advantage of aquatic areas as these have an abundance of food because the water attracts numerous species that serve as prey. All snakes can swim. Aquatic snakes swim particularly well and their movements in water are graceful and swift. Their eyes and nostrils are

placed higher in the head allowing them to breathe and see without raising their head above water. Sea snakes have flattened tails that act like paddles and propel them through the water.

Feeding

Snakes have a wide range of food preferences but all snakes are carnivorous. Only one species of snake has been reported as occasionally feeding on aquatic plants. Snakes eat small mammals such as mice, rats, squirrels, and gerbils. They also



Snake eating a frog

eat birds, lizards, frogs, and small fish. Some apparently also include insects and termites in their diet. Some snakes feed only on other snakes. Some species eat the eggs of other animals including eggs of other snakes and eggs of fishes.

The egg eating snake *Dasypeltis* feeds only on bird eggs; a habit that gave it its name. These snakes do not have teeth. The

mouth lining is pleated much like an accordion so that it can be opened up wide while swallowing eggs. The neck bones of the snake bear spiny projections. Once the egg is in the gullet, the snake bends its neck sharply so the spines pierce the eggshell. The snake swallows the contents but regurgitates the eggshell. Those snakes that only occasionally eat eggs swallow the egg completely and over time digest the shell also. The snake *Cemophora*, for example, feeds on reptile eggs at times. It swallows these whole or cracks them with its teeth. Apparently the *Dasypeltis* is the only snake that regurgitates the eggshell ostensibly to make room for more nutritious egg contents. This may have survival value for the snake as builds up fat reserves that last it during the period when birds do not nest. These snakes avoid eggs with growing embryos and also addled eggs.

Brown snakes (*Storeria dekayi*) have specialized teeth and jaws that allow them to pull snails out of their shells and eat them.

Threadsnakes have teeth only on their lower jaws and mouthparts especially adapted to suck out juices from termite abdomens and discard the less easily digestible parts.

Many snakes change their diet as they grow larger. The young reticulated pythons prey on rats. When they grow to about 4 m (13 ft) in length, they switch to larger prey, such as wild pigs, monkeys, and small deer.

Human beings do not feature on the menu of preferred snake foods. But whatever food snakes do eat, they prefer it alive. Usually snakes do not eat dead or decaying meat. Even in captivity snakes need access to live food though some owners have managed to train them to accept freshly-killed prey. It is common practice to remove the prey if the captive snake doesn't show an interest in it.

Since a snake is not as active as a bird or a mammal it does not burn up its food too quickly and can go without a meal for long periods. Smaller and more active snakes feed oftener than the slow-moving bulkier ones. Boas and pythons can make a big meal last a year or so and even smaller snakes can survive long periods without food.

Drinking Water not Milk

Snakes can survive for a while without water because the bodily fluids of their prey suffice. Also a snake does not urinate but passes a slurry of wastes. This conserves fluids in its body. However, a snake will drink water if it gets a chance to do so. Snakes drink from pools and streams. They can also take up dew and raindrops through the tongue groove in the lip. Snakes that don't have access to freshwater, can get all their water from the juices of their prey.

Milk is not part of a snake's diet and stories about snakes encircling the hind legs of cows and sucking milk from the udders are usually exaggerations based on a lack of observation and understanding. Snakes lack sucking mouthparts and are unable to suck milk from cows. Even if a snake did climb a cow's legs (and come close to the udder) it would have done so for the body heat, not to drink milk.

Catching Prey

Snakes use diverse strategies for capturing their prey. Slender and active snakes often pursue their prey. Those with bulkier bodies, such as pythons, wait in a coiled position and ambush their prey as it passes by. Sometimes they may drop from the overhanging branches as the prey passes below. Small prey such as snails, lizards, worms and frogs are simply held in the jaws and swallowed. Other prey may be pinned to the ground till it ceases to struggle. Sometimes the snake may smother the

prey in its coils and squeeze it so that the prey dies of suffocation...despite commonly held belief the bones are not crushed to a powder and the body to pulp. A venomous bite is also one of the options snakes have to catch prey. Other snakes kill their prey by constriction. Still others swallow their prey alive.

Tracking Prey

Rattlesnakes use poison to immobilise and kill prey. When scientists presented rattlesnakes with two type of mice; one en-venomated and the other non-envenomated; but otherwise similar in all other respects (size, age, sex), the snakes chose the en-venomated mice much more frequently than the other kind. Their choice did not change even when the mice were wrapped in dark nylon mesh that cut off visual or tactile clues. When rattlesnakes were given a choice between following the trail of an en-venomated mouse and a non-envenomated one, they selected the former trail.

Scientists studying the phenomenon speculate that this ability may be because rattlesnakes ambush mice. They bite the mouse but do not restrain it, trusting their venom to do the job. From the snake's point of view this minimises the chances of receiving scratches or bites from a prey in the throes of death. The mouse that has been bitten, dashes away; only to succumb at a distance. The dead rodent is immobile and thus the clues that movement provides are lost. Also, the ability to thermally image may not be of any use if the rat had bolted down a hole before dying there. The snake therefore has to depend on its Vomeronasal organ to pick up chemical clues.

This is exactly what a rattlesnakes does once it has struck successfully at its prey. The strike is necessary to trigger chemo-sensory searching and trail-following behaviour. Chemical clues on the ground are not sufficient

for rattlesnakes and other vipers to follow their prey. Cottonmouths (*Agkistrodon piscivorus*), however, appear to be able to follow the trail irrespective of whether a strike has been successful or not.

There are always two trails that a snake must differentiate between. The first is the trail the prey made as it approached the snake prior to receiving the bite and the second is the trail left as it fled from the site of the encounter. The interesting question that still begs to be answered properly is how the snake “knows” which trail to follow so that it is rewarded with a meal and all that effort is not wasted. Scientists speculate that the protein-digesting enzymes in snake venom break down the prey’s tissues and the snakes have a “perceptual sensitivity” to this. Another idea that is being investigated is that perhaps venom has some “marker chemicals” that help the snake to track envenomated prey. Scientists admit that finding the specific “trail marker” chemical in the cocktail of compounds that form snake venom is not an easy task even in the most modern of laboratories.

Ingesting Prey

Snakes do not chew their food. They swallow it whole and digest at leisure. They cannot chew because their needle-like teeth are not adapted for chewing. Rather these backwardly directed teeth are meant to prevent the prey from escaping. These are specialized to guarantee a one-way downward passage for the prey. Snake teeth grow back when lost. A snake may have several sets of teeth throughout its lifetime. This is necessary, because teeth are often lost while feeding. Some species that feed on hard-bodied prey have hinged teeth to facilitate swallowing while egg-eating snakes have no teeth at all. The type of teeth a snake has differs depending on the method used to capture and kill prey.

Snakes such as large pythons can swallow prey weighing up to 45 kilos. Such prey may take a long time to be ingested. They also produce copious amounts of saliva to ease the passage of the prey. Snakes can push the windpipe forward over their tongue and out of the mouth so that the windpipe is not choked.

Elastic Jaws

It is a common misconception that snakes actually dislocate their lower jaw to consume large prey. The fact is that snakes have a very flexible lower jaw. The two halves of jaws are not



Elasticity and flexibility characterize the jaws of snakes

rigidly attached. Instead muscles and **ligaments** join the bones in their jaws. This arrangement allows tremendous elasticity and flexibility and thus snakes can open their mouths wide enough to swallow their prey whole.

Snakes usually swallow their prey head first. This ensures that the limbs fold easily and do not stick out to hurt its throat.

Once the prey is positioned to the snake's liking the process of swallowing begins. The prey is dragged into the gullet by means of the teeth that are alternately freed and re-fastened in a ratchet-type mechanism. The powerful neck muscles help ease the prey onwards to its final destination. Once the prey is swallowed, the snake realigns its jaws using what has been described as "grimace-like stretches."

As a large prey moves down the gullet of a snake, the snake's skin is stretched. The scales are pulled apart and to an observer, it appears that the skin is in danger of being torn. Usually however, this never happens. The skin is so flexible that it doesn't even tear. Of course there are limits to everything—even flexibility and elasticity. Antlers of big stags can (and do) take the life of the snake, which can neither swallow nor regurgitate it. Snake have been known to die from trying to swallow an animal that is too big. There was a singular tragedy in Florida, USA, (2006) when a large python actually burst trying to swallow an alligator. Talk about overreaching oneself!

But the fact remains that snakes cannot chew and neither can they suckle. And there is a limit to how wide they can open their jaws to swallow their prey.

Internal Organs

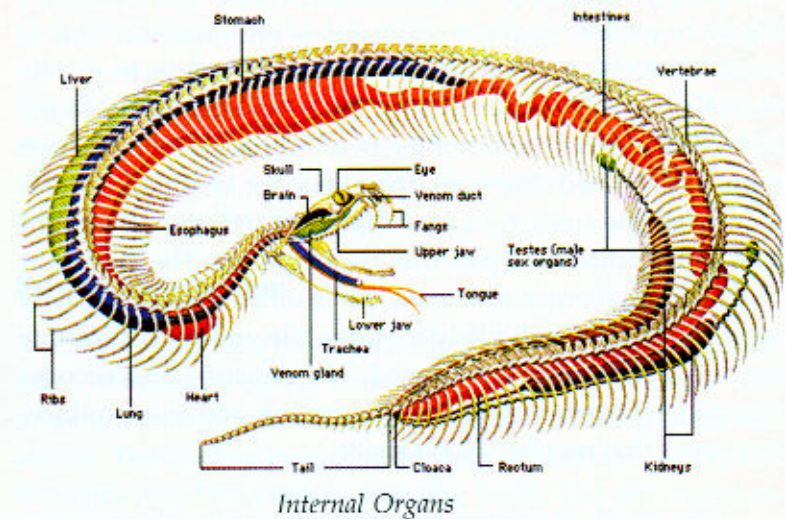
Snakes have tubular or sausage-shaped bodies. Fitting in all the organs in bodies as long and slender as these is no mean feat. Mother Nature requires that all the organs in tubular bodies be long and thin. So it is in the case of snakes.

Many of the paired organs such as kidneys or reproductive organs, are staggered within the body, with one located ahead of the other. This arrangement allows for optimum utilization of the rather limited body space.

Digestive System

A snake's digestive process is highly efficient, dissolving and absorbing everything except hair and claws. The prey's bones are completely digested in 72 hours. But snakes need time to completely assimilate their food.

The digestive systems of intermittent but heavy-feeders differ from that of the more regular feeders. In the former there



is remarkable increase in metabolic rate, rate of nutrient transport cross the gut wall and even in the mass of the intestinal tissue as compared to the resting stage. Once digestion is over, the gut degenerates into an inactive stage. Those snakes that feed more often have guts that remain in a state of preparedness to digest food. It is thought that this ability to up-regulate or down-regulate the digestive system depending on the availability of food evolved as a way to conserve energy, particularly in vipers and pythons that feed infrequently.

After a meal, snakes become torpid while the process of digestion takes place. The pronounced lump in the mid-section of the snake that has just had lunch (or dinner) is evident even to a casual observer. There have been cases of bloated snakes stranded on roads. Situations such as these call for human intervention so that the snakes can be taken to safer locations to let them digest their meals away from danger.

The snake's digestive system is composed of the oesophagus, stomach, small intestine, colon, and associated digestive glands. Snake oesophagus is not muscular and so food has to be helped on its way to the stomach, not by oesophageal movements, but by the movement of the entire body. The junction between the oesophagus and the stomach is not well defined. The stomach has interior longitudinal folds to increase the surface area for digestion and absorption. The liver, gall bladder, and pancreas are all present. The liver is the largest internal organ in a snake. As in other animals, the liver secretes bile. The gall bladder stores bile and releases it into the small intestine when needed. The pancreas also secretes digestive enzymes into the small intestine, and also produces hormones that regulate blood sugar.

The small intestine is basically a long tube that receives food from the stomach, absorbs nutrients from it, and transports it to the large intestine. The fecal matter is transported to the cloaca— a common chamber, receiving products from the digestive, urinary, and reproductive systems—and voided via the cloacal opening.

The energy needs of reptiles are sevenfold to tenfold lower than that of warm-blooded animals such as birds and mammals. Then again, this dips to a further low at night when decreasing temperature reduces the snake's energy use even more (In contrast mammals must produce additional heat to

maintain their body temperature). The lower metabolic demands of snakes mean that they have a low demand for food resources and can withstand periods of food scarcity related to weather changes or other factors.

Three-chambered Hearts

As in other animals, the heart is covered by a membrane called pericardium. The heart of snakes is three chambered. It has two atria and one ventricle. The right and left atria receive blood from the lungs and body, respectively, and pass it to the ventricle to be circulated again. Since snakes have no diaphragm, the heart can be moved about a little to accommodate prey that is being swallowed. This adjustment protects the heart from potential damage when large prey is passes through the oesophagus.

Respiratory System

The snake respiratory system is similar to the basic pattern in other animals though certain significant differences are also present. It includes the windpipe (trachea), bronchi, lungs, and air sac. The trachea begins at the back of the oral cavity, and branches into two bronchi near the heart. The left bronchus leads to the left lung. The right bronchus leads to the right lung. Only one lung is functional in snakes. The left lung is very small or sometimes even absent. The functional lung contains an anterior portion that is rich in blood vessels. It is here that gas exchange takes place. The posterior portion is the "saccular lung" and it does not function in gas exchange. Instead it is used to adjust buoyancy in some aquatic snakes though what it does in land-dwelling snakes remains a bit of a mystery. Because snakes do not have a diaphragm, air enters and leaves the lung due to action of the body muscles and movement of the ribs.

Excretory System

The kidneys are the excretory organs in snakes too. Snake kidneys are elongated, and the right kidney is situated higher up in the body than the left. Staggering of organs is common in animals that have a tubular body. Kidneys filter the blood and remove waste products. These are then concentrated and transported, via hollow tubes called ureters, to the cloaca. Snakes do not have a urinary bladder and so do not store urine over extended periods. They also do not pass watery urine. Excretion of insoluble uric acid as the main nitrogenous waste product helps snakes to conserve water.

Finding a Mate

The sexes are separate in snakes. So a snakes may be either a male or a female. Female snakes leave a chemical (pheromone) trail on the ground as they move. The pheromone attracts adult males of the same species. If more than one male reaches the female at the same time there may (or may not) be a fight. In some species the competing males ignore each other while lavishing attention on the female. In other species they engage in ritual combat dances, in which they intertwine their bodies and try to force down one another's heads. The larger male usually wins. Biting is generally not involved, although in a few species, particularly the non-poisonous ones, the males bite each other quite viciously.

Once a male and female find each other there may (or may not) be a courtship display. This involves actions such as crawling through each others coils, chasing the female, raising the front part of the body while holding the head close to its mate (like a lyre) and dancing together. The courtship displays differ from species to species. Some species have dispensed with the displays totally. There is little or no interaction between male and female snakes after mating. The rare exception is the

western diamondback rattlesnake, males of which remain with the females a few days before and after mating.

Reproductive System

The paired gonads, testes in the male and ovaries in the female, are staggered with the one on the right being higher up in the body than the left. All snakes employ internal fertilization, which means that the male germ cells are inserted into the female's body where they fertilize the female germ cells. Snake sperms are transported from the testes through a duct to the cloaca of the female. The male does this by means of paired, forked hemipenis. The recklessly adventurous can look for the hemipenis on the tail...if the paired structure is present; the snake is a male. A female snake can store sperm for several years, and can produce young two or three years after her last contact with a male snake. It is still not clear how snakes manage to do this.

Laying Eggs and Giving Birth

Most snakes lay eggs. A female snake with eggs in her body is called "gravid". The eggs are large in size and leathery in texture. Snake eggs are white or cream in colour. Usually the eggs are laid in clutches and the mother snake abandons them shortly after laying. The number of eggs per clutch varies from species to species. Large pythons lay 50-100 eggs at a time. Preferred sites for egg laying are wherever moist-heat is available. Places such as mounds of rotten vegetation, tree stumps and decaying logs are desirable for egg laying from the snake's point of view. The eggs hatch in about 8-10 weeks.

Not all snakes lay eggs. Some species are ovoviviparous and retain the eggs within their bodies until they are ready to hatch. The rattlesnake is an ovoviviparous species. There are some snakes that appear to nourish their embryos or

developing young more or less like mammals do. These are the viviparous snakes that also give birth to live young. The lifespans of snakes in the wild is not known with certainty but in zoos, snakes have survived for up to 30 years.

Parental Care

Parental care is limited to very few species and even in those species it does not seem to be highly developed. Of course, for the first few days after hatching, the yolk sacs provide nutrition but after that, the newborn is absolutely its own. Most baby snakes are on their own immediately after hatching.

Though snakes are not celebrated for the parental care shown to their young, female pythons are known to coil around the eggs in a protective embrace. She contracts her muscles in "shivering" movement to produce heat if the ambient temperature is cool. In this way she can keep her eggs at a temperature of 29° C. This aids in the hatching of the eggs. The female rattlesnake has been known to keep the eggs warm by basking in the sunlight. King cobras are the only snakes to make nests. These consist of a two-storeyed mound of leaves (usually bamboo leaves). The female makes these nests by whipping the leaves into the desired shape using her coils. The eggs are laid in a bottom chamber. The female stays coiled in the upper layer and on guard for about two-months. Mongoose are notorious thieves of king cobra eggs. The female king cobra is quick to defend her nest against intruders although she usually does not attack humans. Just before the eggs hatch, the female goes away, possibly in search of food after a two-month fast...or perhaps to get away from the temptation of feasting on her newborns after the enforced period of starvation.

Recently it has been found that female black-tailed rattlesnakes stay with their young until they complete their

first shedding of skin in about a week's time. Similar observations have been made for the rock rattlesnake. It is thought that the presence of the female rattlesnake nearby keeps predators away and increases the chances of survival for the newborn. It is believed that this may allow the newborns to familiarise themselves with the odour and scent trails that will, later on, allow them to find their way to the den for hibernation.

Scientists are now speculating that further studies on other species may reveal more examples of parental care in snakes than has been reported till now.

Independent Newborns

The babies use the "egg tooth," a sort of protuberance on the tip of the snout to slit the birth membrane (or hatch out eggs) before slithering free. They shed this tooth soon afterwards.

Snake babies are born as perfect but miniature editions of the adults. This means that juveniles of poisonous snakes



Newborns of snakes are independent

have fully functional fangs and poison glands. One of the first things the newly emerged baby does is to find a crack or crevice to call its own. Baby snakes are vulnerable to predation by a host of animals including insects. Even the venomous hatchling cobras fall prey to civet cats and mongoose, not to forget even swarms of ants.

Winter Sleep/Summer Sleep

Snakes are ectotherms and cannot maintain a steady body temperature. Usually their body temperature is plus or minus one degree with respect to the ambient temperature. They are not comfortable when the temperature is too hot or too cold. Optimal temperature for most snakes ranges between 20-35°C. They are unable to move around if the temperature drops below 4°C and die if the temperature goes above 40°C. When temperatures become too hot for comfort, snakes seek shelter in shady places. When conditions further deteriorate, snakes seek out protected sites, such as underground dens. Here they enter a state of reduced activity or hibernation. During hibernation, a snake's body temperature may drop to 5°C. Some snakes such as the red-sided garter snake, which is usually a solitary species, congregate in large numbers for the winter sleep. Scientists say this is actually the result of a shortage of adequate shelters and not because of any desire for company.

Snakes that live in hot tropical areas spend much of summer in a state of limited activity. This is called aestivation.

Evolutionary History

The evolutionary history of snakes is inadequately known. Snake skeletons are fragile and therefore poorly preserved as fossils. The oldest known snake fossils are about 100,000,000 years old. Scientists call this the Cretaceous period. However,

the fossil appears to be that of a pretty specialized snake, not that of an ancestral one so it tells us nothing new.

Without proper fossil records it is difficult to prove any argument with any degree of conviction. However, most scientists agree that snakes descended from lizard-like ancestors. Some snakes such as the boas still retain traces of hind limbs. These are tiny, clawed digits known as anal spurs and are used, not for locomotion, but to grasp during mating. No snake has a breastbone for the attachment of forelimbs.

What they debate is how (and why) the lizard-like ancestors lost their legs, external ears, eye lashes and sundry other organs while gaining transparent, fused eyelids and other distinguishing characteristics.

One school of thought says that snake ancestors inhabited areas with thick vegetation that prevented them from running around on legs. So the animals evolved to become legless and elongated so that they could slither around.

Another school of thought says that the ancestors of snakes lived underground and their eyes and limbs degenerated over time because the burrowing way of life did not need limbs or keen eyesight. They say that the powers of vision "re-evolved" when some snakes changed their habitat preferences and came to live above ground.

Snakes on the Menu

Natural Predators of Snakes

Animals that feed on snakes are called Ophiophagus. The term *Ophio* refers to snakes and *phagus* is Latin for eating, so the name literally means snake-eater.

Crows, ravens, coyotes, weasels, mink, raccoons, foxes, ground squirrels, skunks, hawks, owls and other predators kill and eat snakes. The common domestic cat also catches and eats snakes if it gets a chance.

Many species of owls and hawks as well as storks and kingfishers love to eat snakes. There are three species of snake-eagle (*Circaetus*) in Africa, six species of serpent-eagles



Mongoose killing snake

(*Spilornis*) in Asia, and the serpent-eagle (*Dryotriorchis spectabilis*) in the Congo basin, Africa that specialize in eating reptiles, particularly snakes.

The Secretary Bird likes to eat snakes and is a good hunter. It worries a snake, dances around it, jabs at it, stomps on it and repeatedly picks it up and throws it down till the snake dies. Then it eats it.

The Roadrunner is a large, mottled black-and-white ground bird with a distinctive head crest. It is found in America

and is also called the Snake eater because of its fondness of rattlesnakes. It picks up coiled rattlesnakes by their tails and repeatedly slams the snake's head against the ground till the snake dies. Some snakes like to feed on other snakes too. The King cobra is scientifically called *Ophiophagus hannah* and its first name explicitly announces its diet. The common Kingsnake (*Lampropeltis getula*) derives its name from its habit of eating other snakes. Since its diet includes rattlesnakes, copperheads and coral snakes as well as other snakes, it is viewed as being the "King" of snakes. The Kingsnake tracks rattlesnakes at night with its sense of smell. It captures the rattlesnake in its coils and bites it repeatedly. The Kingsnake can tolerate rattlesnake venom so it doesn't seem to mind getting bitten in turn. Once the rattlesnake is exhausted, the Kingsnake swallows it alive.

Snakes on the Dining Table

Snake flesh is considered edible; even a delicacy in some cultures. Even poisonous snakes are edible because the venom sacs with their lethal load are discarded with the head. Sea



Snake flesh is a delicacy in some cultures

snakes and pythons are highly regarded as food wherever snake flesh is eaten.

Cooked rattlesnake meat is eaten in the western United States. Canned garter snake meat is also available. In certain Asian countries the blood of snakes, particularly the cobra, is taken. It is usually mixed with liquor to improve the taste.

Snake wines are drinks relished in many countries such as Vietnam. A large venomous snake is placed into a glass jar of rice wine often with many smaller snakes, turtles, insects, or birds, and left to ferment for many months. Snake blood wine is prepared by draining its blood into a mixing vat with rice wine or grain alcohol. The gall bladder is mixed with wine and cooked snake meat, liver, and skin accompany the drink. Rat snake eggs are also much relished by some.

Uses

Snake skin is used to make leather for bags, wallets, cigarette cases, tobacco pouches and belts. It has even been fashioned



Products from snake skin

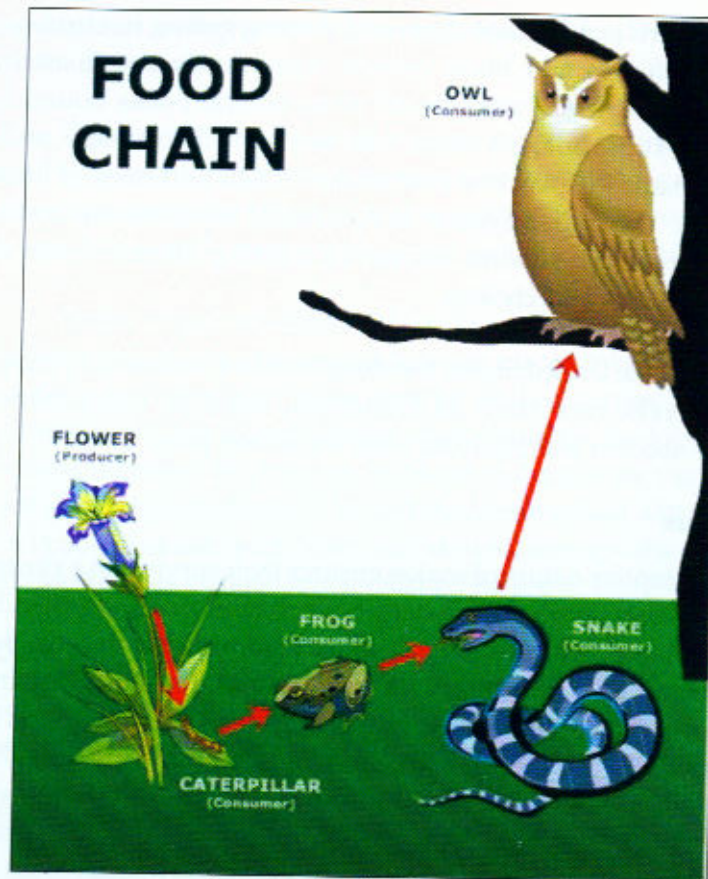
into sports jackets, caps shoes and evening gowns, not to forget lamp shades and book covers. Apparently the Institute Butantan in Sao Paulo, Brazil owns several books bound in snake skin. Snake venom has been used to create anti-coagulants that work to treat stroke victims and cases of heart attack. The Indian system of Ayurvedic medicine has tested various cobra venoms for use in treating diseases such as tuberculosis and cholera.

In the United States, the study of cobra venom has yielded pain relievers such as Cobroxin, used to block nerve transmission and Nyloxin, used for severe pain.

Status

The adaptive nature of snakes ensures their survival in a variety of habitats ranging from deep waters, rainforests, grasslands, woodlands, marshes, mountainous land to sandy deserts. But human population pressure is rapidly and steadily driving snakes to an abyss called extinction. Biologists were slow to notice the decline in snake numbers, but as early as 1975, biologist Robert H. Mount expressed concern for the survival of some snake species. He wrote, "Much of the detrimental habitat manipulation is the result of the increasing human population and its demands on the natural environment. Extensive land clearing, whether for housing, industry, mineral exploration or agriculture, takes a heavy toll".

Destruction of the natural habitat of snakes is caused by agriculture, mining, deforestation for timber and firewood as human settlement encroaches on to what was, till recently, so obviously snake territory. The standard forestry practice of removing dead trees or mature ones with hollows in the trunks leads to the diminishing of shelters/summer homes for the snakes. It seriously threatens the snake populations. But more



A poster showing food chain

importantly, because females are not able to find adequate protection for their eggs, the viability of the next generation becomes uncertain. The resultant decline in snake population can have profound implications for ecological communities and food chains.

In many countries, open areas are set on fire to promote growth of grazing vegetation for domestic animals. The fires directly kill the snakes or leave them without adequate prey/vegetative cover.

The domesticated animals or those introduced by man also play a role in exterminating snakes. Feral cats, rats, or even goats often colonize a snake's habitat. An introduced species of poisonous toad has caused many native snakes to die after eating it. The Cane Toad (*Bufo marinus*) was deliberately introduced from Hawaii to Australia in 1935, to control scarab beetles that were pests of sugar cane. Snakes that feed on these toads (mostly Tiger Snake, Red-bellied Black Snake and Death Adder), die as they have no protection against the poison secreted by the toads. There are records of dead adult Death Adders with these toads still in their mouths. The damage inflicted by these toads is a two-fold one as the young snakes are eaten by larger toads. These toads are the principal cause of decline in Death Adder in Australia.

Many snakes are victims of nest predators such as Raccoons and Skunks. The latter-mentioned species flourish around areas of human settlements and it is estimated that there may be twenty times as many Raccoons in North America now, compared with half a century ago...and of course, a far lesser number of snakes.

The felling of trees affects those snakes that like to live on trees. For example, the Round Island Keel-scaled boa, a rare arboreal snake, prefers trees for both resting and hunting. These snakes originally inhabited tropical hardwood forests but since the introduction of goats and rabbits to the island of Mauritius much of this habitat has been destroyed to make grazing land available. As a result of habitat degradation the boas are currently surviving (barely) in degraded shrub layer vegetation. Once the trees protected it from attack by predatory mammals; but today when these snakes come down to the ground to mate, there are no surrounding trees to provide cover and they are vulnerable to predation/attack by enemies.

Many snakes also depend on trees for protection from the scorching heat of the sun. The decimation of scrub forests in India in favour of agriculture is one of the reasons behind the decline of the Indian python.

The wetlands also serve as primary habitat for many snakes. These may include marshes, swamps, bogs and fens. Some wetlands retain water only part of the year and are considered "ephemeral" wetlands. But even though these are ephemeral in nature, they still provide important habitat and breeding grounds for snakes. The Mexican garter snake, an aquatic species is threatened by the destruction and degradation of rivers and streams. This snake has almost disappeared from most of its range in USA. Its decline is closely linked to the deteriorating quality of streamside habitats and the disappearance of streamside vegetation for cover, and loss of native prey species. It is not the only species facing death-threat due to loss of wetlands and rivers.

What is undoubtedly 'Development' from the human perspective can mean death for ophidians. Roads, the sure signs of development, can be the cause of snake-deaths. Snakes often go on to the warm asphalt roads to bask in the heat and are regularly run over by traffic. Their carcasses are seldom tallied. In one of the few studies that have been carried out, herpetologists have noted dramatic declines of snakes in Paynes Prairie State Preserve near Florida, USA. This area is crossed by two four-lane highways. This preserve was once legendary for its diversity and density of snakes, but not any more. Similarly, a study of south Florida (USA) herpetofauna (snakes and amphibians) has attributed declines in many snake-populations to the increasing road traffic in that region. This has far-reaching consequences that become apparent only on taking a detailed and close look. Scientists have highlighted the fact that "*populations of many animal species divided by a heavily*

travelled road may be just as isolated from one another as if they were separated by many miles of barren urban or agricultural land". They have called this "triple jeopardy" pointing out that, "At the same time that development reduces the total amount of habitat, squeezing remaining wildlife into smaller and more isolated patches, the high-speed traffic of larger and wider highways eliminates more and more of the remaining populations". Some conservationists have suggested the creation of protected corridors. But the problem of training or motivating the snakes to use these appears to be an insurmountable one, even if such corridors are actually created for the threatened reptiles.

Snakes that live near, or on, agricultural fields run the risk of pesticide poisoning. Pesticides have the tendency to accumulate in the body of the predator. The higher up the food chain a species is, the more pesticide residue is found in its body. This is called bio-magnification. The pesticide is concentrated in the body-fat of the frog when it feeds on insects that have been sprayed with the pesticide. Now, if a snake feeds on this frog, the pesticide will find its way into the body-fat of the snake and will be further concentrated there.

Though the effects of pesticides on mammal and bird populations have been widely documented, the effects on reptiles are only now being investigated. One reason may be that snakes are, due to their secretive nature, not readily observed.

In a few cases, however, the connection between pesticides and snake deaths are fairly clear-cut. Dieldrin, a pesticide sprayed to control the tsetse fly that spreads sleeping sickness, has directly led to many snake deaths. Pesticides can cause a number of other problems for snakes. These include causing endocrine disorders; laying of thin-shelled eggs, inability to lay viable eggs; deformities in young snakes, and

killing off a snake's prey animals/contaminating the prey so that the snake is then poisoned by its food.

Not enough is known about the state of the actual pesticide load in snake tissues in the wild though studies have indicated that snakes near cotton fields carry high amounts of pesticide residues in their bodies. However, judging by the fact that non-target animals such as fish and frogs have been found to carry impressive loads of contaminants, it would not be wrong to say that perhaps there is cause for alarm.

However, even if endangered snake habitats are preserved and made safe from pollutants snakes still face the danger of people who search for and kill them out of fear or for sale as food/leather. There is also a rising trend of keeping certain species of ornamental snakes as pets, so such snake populations are also under pressure.

Snakes also face a lot of prejudice arising from human ignorance and many snake-deaths can be attributed to this. For example, Rattlesnake roundups take place in at least six states of USA. Every year, thousands of rattlesnakes are captured and slaughtered in these public events. In India, snakes used by snake charmers are often cruelly de-fanged or have their mouths sewn up so that they cannot bite (or eat). These snakes die a lingering death, literally starving till they breathe their last.

The decline in snake populations worldwide is bad news. Whether we recognise it or not, snakes are vital members of the ecosystem, irrespective of where they live. Many snakes feed on slugs, snails, and insect pests and so they are a farmer's friend. Other species of snakes play an important role in controlling grain-eating rodent populations. Left unchecked these small mammals have the potential to cause great damage

to agricultural fields. Snakes therefore play a vital role in the ecology of an area and the economy of the country. They control the rodent population, which, if left unchecked, can reach plague proportions and devastate cereal crops.

Perhaps the dwindling snake population has rung an alarm bell in the minds of the people. Certain NGOs and individuals, particularly in and around Bangalore, have launched a public service whereby they answer calls from citizens whose houses have unwanted ophidian visitors. The trained snake catchers seek out and capture the snake. They take it away, alive and unhurt, either to be released back in the wild or to be cared for in captivity. In either case, the snake escapes a brutal death. The snake catchers report that public opinion is showing a slight change. Most people pause to ring up the snake catchers instead of beating the snake to death. They also insist that the snake be released in the wild. The silver lining to the hitherto gloomy tale is that, in recent times, animal documentaries on television have gone a long way in increasing the awareness about these creatures. In this context perhaps it is pertinent to point out the role played by channels such as *Discovery*, *Animal Planet* and *National Geographic* to name but a few, in educating the masses and introducing them to the beautiful and secretive world of snakes.

On the scientific front too herpetology is increasingly coming into focus. A few of the organisations and institution in India that are carrying out research on snakes are: the Zoological Survey of India, World Wide Fund for Nature (WWF), Wildlife Institute of India (Dehra Dun), The Madras Crocodile Bank Trust (this also the parent organization for the Irula Snake-Catchers Industrial Cooperative Society), and Aranyak, an NGO based in Guwahati. The Madras Crocodile Bank Trust was set up in 1976 and today it is home to many species of crocodiles, turtles, lizards and snakes. It is also a

premier institution for herpetological research and houses one of the best herpetological libraries in Asia. But there is no doubt that lots more needs to be done to bring succour to these much-maligned yet mild-mannered creatures.



Madras Crocodile Bank Trust setup in 1976 is a premier institution for herpetological research in India



3

Interesting Trivia

Sea Snakes

Sea snakes are snakes that live in the seas. Most are found in the tropical areas of the Indian and the Pacific Oceans. Though superficially these snakes resemble eels, they are not fish. They differ from eels in that they don't have gill slits and have scales. They do not breathe dissolved oxygen from the water but need to surface from time to time. Their nostrils have valves that close the orifices when they are underwater. Sea snakes grow to lengths of 91-122 cm and have specialized flattened tails for swimming. Due to their need to breathe air, these are usually found in shallow waters; rarely at depths greater than 46 meters. They mostly swim near the bottom feeding on fish, fish eggs and eels. All sea snakes are poisonous although most are non-aggressive, even docile. They use their venom to kill fishes on which they feed. Most sea snakes give birth to live young in the water but a few species do come ashore and lay eggs.

There are no Sea snakes in the Atlantic Ocean, the Mediterranean Sea and the Red Sea.

"Flying" Snakes

Snakes belonging to the genus *Chrysopelea* are good gliders and their aerial feats have earned them the name "Flying" snakes. These are a small group of mildly poisonous snakes that live in the trees of the lowland tropical rainforests of Southeast and South Asia. They appear to fly by flattening the entire body, and gliding or parachuting to the ground or to another tree. Despite the name, these snakes do not have wings and do not fly; they merely glide.



Flying Snake

Spitting Cobra

Four out of seven species of cobras found in Africa, and seven out of nine species found in Asia, can spit to varying degrees. To be accurate, a spitting cobra does not "spit" poison; it sprays it. A muscular contraction pushes the venom from the bottom of the cobra's fangs, while air expelled from the cobra's lung sprays the venom. The distance up to which the venom can be sprayed is up to 2 meters. Cobras only spit when they feel threatened. They bite in the usual way to kill their prey.



Spitting Cobra

These snakes have the reputation of being able to spit accurately into the eyes of its victims. They move their heads extremely rapidly when squirting the toxin. This sprays the

venom over a larger area, increasing the chance that of hitting at least one eye. The cocktail of toxins partly consists of nerve poisons, but also contains components, which are harmful to tissue. If the snake does hit an eye, the sensitive cornea reacts with severe stinging pain. In the worst-case scenario the burns can ultimately lead to blindness.

Under experimental conditions these snakes have shown remarkable accuracy. The black-necked spitting cobras hit at least one eye eight out of ten times, and the red Mozambique spitting cobras reached the perfect score by hitting the target in 100 per cent of cases.

Snake Charmers

The snake charmer appears to make snakes dance to his tunes by playing on his 'been' or flute-like musical instrument. The truth is that a snake has no sense of hearing, as we understand it. The dancing snake merely responds to the vibrations from the tapping of the snake charmer's foot and to his circular hand movements.

The Irulas

Irulas from Andhra Pradesh and Tamil Nadu are experts at tracking and catching snakes using traditional methods. In the recent past they used to kill the snake and sell the skin to be used as leather. However, with the growing realization about the role that snakes play and stringent implementation of wildlife laws, the Irulas have put their formidable skills, honed over generations to other use. Today they are one of the most skilled people that regularly catch snakes for the production of anti-venom in India. The Irula Extraction Cooperative Society integrated their proficiency in catching poisonous snakes with a project to make anti-venom serum.

Snake Trivia

- The word Snake is derived from Old English *snaca* meaning “to crawl”.
- Herpetology is the branch of zoology concerned with the study of reptiles and amphibians.
- Love of snakes is called ophiophilia.
- Fear of snakes is called ophidiophobia.
- A snake specialist is called an ophiologist.
- Two medical symbols involving snakes are still used today. These are Bowl of Hygieia, symbolizing pharmacy, and the Caduceus and Rod of Asclepius, denoting medicine in general.
- Snakes are worshipped in India on Nagpanchami day.
- Snakes do not drink milk. No reptile secretes or drinks milk. Milk is a mammalian phenomenon.
- Snakes have no ears or movable eyelids.
- The king cobra delivers enough poison per bite to kill an elephant, or 20 people.
- Baby snakes are more dangerous than adults. Adult snakes ration out their venom. Baby snakes show no such restraint. They deliver a much higher dose of venom in their bites.
- Jacobson’s organ is found in human embryos, but it degenerates as the nervous system develops.
- Pipesnakes have flattened tails that resemble cobra hoods. The actual head remains hidden within the coils, ready for a counterattack. This probably gave rise to the myth of two-headed snakes.
- Green pythons may be yellow or brown when they hatch. They turn green when they grow older.
- A Gaboon viper in a zoo once fasted for two years and six months.
- The flag of Mexico shows an Eagle eating a snake.

- Shredded skin of Boomslang (*Dispholidus typus*), a colubrid snake, is one of the ingredients to make the Polyjuice Potion in *Harry Potter and the Chamber of Secrets*.
- The poison of the Boomslang also features in Agatha Christie’s *Death in the Clouds*.
- All Brahminy blind snakes are females and reproduce through an asexual process known as parthenogenesis. Marine file snake or Little file snake is also believed to be parthenogenetic.
- *Enhydryis*, a snake found deep in the forests of Borneo can change colours just like its celebrated cousin, the chameleon. The genus *Enhydryis* includes 22 species. Apparently the specimen captured by Dr Mark Auliya, a German reptile expert, changed from being reddish-brown to white within the short span of a couple of minutes.

Some Serpentine Records

The smallest snake: Dwarf blind snake (*Leptotyphlops humilis*) is only 10 cm long. Another tiny snake, the Brahminy blind snake (*Ramphotyphlops braminus*) grows to length of about 15 cm only.

Longest Snake: The Reticulated python (*Python reticulatus*) was recognised as the longest snake with the maximum verified length of 10.1 meters.

Heaviest Snake: The Green anaconda, however, is the heaviest snake in the world, and can grow up to about 130 kgs.

Most venomous snake: The Hook-nosed seasnake (*Enhydrina schistosa*) from The Persian Gulf to Southern Asia is considered to be the most poisonous. Its venom is estimated to be 100 times more potent than the King cobra.

Deadliest land snake: The King cobra (*Ophiophagus hannah*) from India eastward to Vietnam, southern China, and the Philippines, and Southeast Asia through Malaysia and Indonesia. It is also considered the longest venomous snake, averaging 3m with the longest verified length at 5.58m. Although its venom may not be as toxic as the Hook-nosed seasnake, the King cobra can inject a larger quantity of venom. Its glands can contain about 6 millilitres of venom, which is enough to kill an Asian elephant.

The shortest venomous snake: The Narqua dwarf adder (*Bitis Schneideri*) from Namibia, Africa reaches only 20cm or about the length of a drinking straw.

The biggest snake that ever lived: The giant African python (*Giagantophis garstini*) that lived 55 million years ago in Africa. It was about 11.8m long.

The longest fang: This belongs to the Gaboon viper (*Bitis gabonica*) of Africa. Its fangs are more than 5cm long from base to tip.

The fastest snake: This is believed to be the black mamba (*Dendroaspis polylepis*) of Africa. It is reputed to be able to travel up to 14-19 km/h in short bursts. It is also considered to be the second largest venomous snake in the world.

Iridescent snake: The sunbeam snake (*Xenopeltis unicolor*) of Asia is a burrowing species that shows a rainbow burst of colours on its scales in the sunlight.

The Big Four Venomous Snakes in India: Indian cobra, (*Naja naja*); Common krait, (*Bungarus caeruleus*); Russell's viper, (*Daboia russelii*); Saw-scaled viper, (*Echis carinatus*).

List of Snakes found in India*

1. Brahminy Blind snake (*Ramphotyphlops braminus*): Widely distributed. This snake is also called Flowerpot Blind snake because it has been unknowingly transported the world over, hidden in the soil in the flowerpots. Called *Andha saanp* in Hindi.
2. Giant Blind snake (*Typhlops diardii*). Found in North-eastern India.
3. Slender Blind snake (*Typhlops porrectus*).
4. Belgaum Worm snake (*Typhlops exiguus*). Found in South and South-western India.
5. Beddome's Worm snake (*Typhlops beddomii*). This snake has been named after Richard Henry Beddome, British army officer and botanist. Found mostly in Tamil Nadu, Andhra Pradesh.
6. Andaman Worm snake (*Typhlops andamanesis*). Found on the Andaman Islands.
7. Beak nosed Worm snake (*Rhinotyphlops acutus*). Mostly restricted to peninsular India.
8. Nilgiri Hills Worm snake (*Typhlops tindalli*). Found in the Nilgiri Hills and the Western Ghats.
9. Thurston's Worm snake (*Typhlops thurstoni*). Found in South India.
10. Samagutin Worm snake (*Typhlops tenuicollis*). Found in the Naga Hills.
11. Peninsular Worm snake (*Typhlops pammeces*). Found in South India.
12. Few-scaled Worm snake (*Typhlops oligolepis*). Found in North India, particularly in Nagri valley, around Darjeeling.
13. Andaman Island Worm snake (*Typhlops oatesii*). Found on the Andaman Islands.
14. Darjeeling Worm snake (*Typhlops meszoelyi*). This snake was named after Dr. Charles A.M. Meszoely, Center for

- Vertebrate Studies, Northeastern University, Boston, USA.
 Found in West Bengal.
15. Loveridge's Worm snake (*Typhlops loveridgei*). This snake is named after American herpetologist Arthur Loveridge. Found in North India.
 16. Nilgiri Worm snake (*Typhlops fletcheri*). Specimens collected from the Nilgiri Hills.
 17. *Typhlops jerdoni*. Found in Assam, particularly in the Khasi Hills.
 18. Palni Shieldtail snake (*Brachyophidium rhodogaster*). Found in South India particularly around the Palni Hills.
 19. Two-lined Black Shieldtail (*Melanophidium bilineatum*). Found in the Western Ghats. Known from only three specimens.
 20. Beddome's Black Shieldtail (*Melanophidium punctatum*). Found in the Western Ghats.
 21. Indian Black Earth snake (*Melanophidium wynaudense*). Found in the Western Ghats.
 22. Travancore Hills Thorntail snake (*Platyplectrurus madurensis*). Found in the Western Ghats.
 23. Lined Thorntail snake (*Platyplectrurus trilineatus*). Found in South India.
 24. Kerala Shieldtail (*Plectrurus aureus*). Found in the Western Ghats.
 25. Kanara Shieldtail (*Plectrurus canarius*) Found in Southern India.
 26. Günther's Burrowing Snake (*Plectrurus guentheri*). This snake was named after zoologist Albert Günther. Found in the Western Ghats.
 27. Nilgiri Burrowing snake (*Plectrurus perroteti*). Found in South India and the Western Ghats.
 28. Cardamom Hills Earth snake (*Rhinophis fergusonianus*). Found in South India.
 29. Salty Earth snake (*Rhinophis sanguineus*). Found in the Western Ghats.

30. Travancore Shieldtail (*Rhinophis travancoricus*). Found in South India.
31. Purple-red Earth snake (*Teretrurus sanguineus*). Found in South India.
32. Madurai Earth snake (*Uropeltis arcticeps*). Found in the Western Ghats, south of Palghat.
33. Beddome's Earth snake (*Uropeltis beddomii*). Found in South India.
34. Brougham's Earth snake or Sirumallay's Uropeltis (*Uropeltis broughami*). Found in South India.
35. Ceylon Earth snake (*Uropeltis ceylanicus*). Found in the Western Ghats.
36. Sirumalai Hills Earth snake or Dindigul Uropeltis (*Uropeltis dindigalensis*). Found in South India.
37. Elliot's Earth snake (*Uropeltis ellioti*). Found in South India, the Western, and the Eastern Ghats.
38. Günther's Earth snake (*Uropeltis liura*). Found in South India.
39. Bombay Earth snake (*Uropeltis macrolepis*). Found in southern India, particularly in Maharashtra.
40. Anaimalai Earth snake or Ponachi Uropeltis (*Uropeltis macrorhynchus*). Found in South India.
41. Spotted Earth snake (*Uropeltis maculates*). Found in South India.
42. Boulenger's Earth snake or Myhendra Mountain Uropeltis (*Uropeltis myhendrae*). Found in South India.
43. Southern Earth snake or Cochin Shieldtail (*Uropeltis nitidus*). Found in South India.
44. Ocellated Shieldtail or Nilgiri Uropeltis (*Uropeltis ocellatus*). Found in South India, the Western Ghats, common in the Nilgiri and Annamalai Hills.
45. Shieldtail Earth snake (*Uropeltis petersi*). Named after German herpetologist, Wilhelm Peters. This snake is found in South India.
46. Phipson's Shieldtail (*Uropeltis phipsonii*). Named after H.

- M. Phipson, one of the founders of the Bombay Natural History Society. This snake is found in the Western Ghats.
47. Indian Earth snake (*Uropeltis pulneyensis*). Found in the Western Ghats.
 48. Red-lined Earth snake or Travancore Uropeltis (*Uropeltis rubrolineatus*). Found in South India, Western Ghats south of the Palghat Gap to Bhimshankar.
 49. Red-spotted Earth snake (*Uropeltis rubromaculatus*). Found in South India.
 50. Smith's Earth snake (*Uropeltis smithi*). Found mostly in Anamallay forests.
 51. Woodmason's Earth snake (*Uropeltis woodmasoni*). Found in South India particularly Annamalai and Palni Hills, Travancore, Tinnevely, and Nilgiris.
 52. Wart snake or Marine File snake or Little File snake (*Acrochordus granulatus*). Found in brackish estuaries and also Indian seas including the water around Nicobar Islands.
 53. Common Sand Boa or Rough-tailed Sand Boa or Rough Scaled Sand Boa (*Gongylophis* (previously *Eryx*) *conicus*). Found in the sandy tracts of central and southern India, Punjab and Kutch.
 54. Red Sand Boa or Brown Sand Boa or Indian Sand Boa (*Eryx johnii*). Called *Do-muha* or the two-mouthed snake in Hindi. The name is derived from the resemblance the tail bears to the head, and the snake's habit of coiling up and raising the tail as if it were the head when alarmed. Found in Western India.
 55. Whitaker's Sand Boa (*Eryx whitakeri*) Found in Southwest India.
 56. Indian Rock Python (*Python molurus*). Widely distributed. Called *Ajgar* in Hindi.
 57. Reticulated Python (*Python reticulatus*) Particularly in Arunachal Pradesh and the Nicobar Islands.

58. Sunbeam snake or Ngooh moh (*Xenopeltis unicolor*). Found in the Nicobar Islands.
59. Gunther's Vine snake (*Ahaetulla dispar*). Found in Southwest India.
60. Green Vine snake (*Ahaetulla nasuta*). Widely distributed excluding the Northeast.
61. Oriental Green snake or Oriental Whipsnake (*Ahaetulla prasina*). Found in eastern and north eastern India, particularly Assam and Arunachal Pradesh.
62. Brown Vine snake or Brown-speckled Whipsnake (*Ahaetulla pulverulenta*). Found in Southwest India, particularly the Western Ghats.
63. Wall's Bronzeback or Blue Bronzebacked Treesnake (*Dendrelaphis cyanochloris*). Found in Assam, Arunachal Pradesh, Andaman and Nicobar islands.
64. Painted Bronzebacked Treesnake (*Dendrelaphis pictus*) Arunachal Pradesh. Andaman Islands.
65. Common Bronzebacked Treesnake (*Dendrelaphis tristis*). Found almost all over India at elevations lower than 2000 m.
66. Tiwari's Bronzeback (*Dendrelaphis humayuni*). Found in the Nicobar Islands.
67. Southern Bronzeback (*Dendrelaphis grandoculis*). Found in the Western Ghats.
68. Gore's Bronzeback or Himalayan Bronzeback (*Dendrelaphis gorei*). Found in West Bengal, Assam and Arunachal Pradesh.
69. Ornate Flying snake or Golden Flying snake (*Chrysopelea ornata*). Found in southern, eastern and northeastern India particularly West Bengal, Bihar, Orissa, Western Ghats.
70. Sri Lankan Flying snake (*Chrysopelea taprobanica*). Found in Southwest India.
71. Paradise Flying snake (*Chrysopelea paradisi*). Found in Andaman Islands.

72. Boulenger's Keelback (*Amphiesma parallelum* (previously *parallela*)). Found in Sikkim, Assam and Arunachal Pradesh.
73. Eastern Striped Keelback (*Amphiesma platyceps*). Found in Kashmir, Sikkim, Punjab, Assam, West Bengal, Meghalaya, and Arunachal Pradesh.
74. Buff-striped Keelback (*Amphiesma stolatum*). Widely distributed in India, including the Andaman Islands.
75. Khasi Hills Keelback (*Amphiesma khasiense*). Found in Assam and the northeastern parts of India.
76. Hill Keelback (*Amphiesma monticola*). Found in the Western Ghats.
77. Nicobar Island Keelback (*Amphiesma nicobariense*). Found in the Nicobar Islands.
78. Assam Keelback (*Amphiesma pealii*). Found in Assam.
79. Wall's Keelback (*Amphiesma xenura*). Found in Assam.
80. Modest Keelback (*Amphiesma modestum*). Found in Assam.
81. Sikkim Keelback (*Amphiesma sieboldii*). Found in Uttar Pradesh, Sikkim, and Punjab.
82. Eastern Water Snake or Olive Keelback (*Sinonatrix percarinata*). Found in Arunachal Pradesh.
83. Banded racer (*Argyrogena fasciolata*). Found in Maharashtra.
84. Glossy-bellied racer or Hardwicke's Rat Snake (*Coluber ventromaculatus*). Found in northern and western India, Uttaranchal, Maharashtra.
85. Braid Snake or Jan's Cliff Racer or (*Coluber rhodorachis*).
86. Spotted Desert Racer or (*Coluber karelini*). Found in North India.
87. Graceful Racer or (*Coluber gracilis*). Found in Maharashtra and Madhya Pradesh.
88. Sharma's Racer (*Coluber bholanathi*).
89. *Coluber vittacaudatus*. Found in West Bengal.

90. Indian Smooth snake (*Coronella brachyura*). Found in Maharashtra.
91. Chinese Ratsnake or Indo-Chinese Ratsnake (*Ptyas korros*). Found in Assam and Arunachal Pradesh.
92. Indian Ratsnake or *Dhaman* or Oriental Ratsnake (*Ptyas mucosus*). Widely distributed in the plains of India, Found in Maharashtra, Karnataka and the Andaman Islands.
93. Green Ratsnake or Black-margined Ratsnake (*Ptyas nigromarginatus*). Found in West Bengal, Assam and Sikkim.
94. Dog-faced Watersnake or New Guinea Bockadam (*Cerberus rhynchops*). Widely distributed in India particularly in rivers and coastal areas including Andaman and Nicobar Islands.
95. Green Keelback (*Macrophistodon plumbicolor*). Common snake of the hills.
96. Dussumier's Smooth Watersnake (*Enhydryis dussumieri*).
97. Common Smooth Watersnake or Rainbow Watersnake (*Enhydryis enhydryis*). Found in Uttar Pradesh, Bihar, West Bengal, Assam and Orissa
98. Cat-eyed Fishing snake (*Gerarda prevostiana*). Found in coastal and tidal rivers of Maharashtra and the Malabar Coast.
99. Dark-bellied Marsh snake or Painted Keelback (*Xenochrophis cerasogaster*). Found in Assam, West Bengal, Uttar Pradesh.
100. Andamanese Keelback water snake (*Xenochrophis melanostus*).
101. Plumbeus Smoothsnake (*Enhydryis plumbea*).
102. Siebold's Water snake (*Enhydryis sieboldii*).
103. Checkered Keelback or Asiatic Watersnake (*Xenochrophis* (previously *Natrix*) *piscator*). Called *Pani saanp* in Hindi.
104. Yellow-Spotted Keelback (*Xenochrophis flavipunctatus*).
105. *Xenochrophis punctulatus*. Found mostly in eastern India.

106. St. John's Keelback (*Xenochrophis sanctijohannis*). Found in Kashmir.
107. Triangle Keelback (*Xenochrophis trianguligerus*). Found in Nicobar Islands, Arunachal Pradesh.
108. White-bellied Mangrove snake (*Fordonia leucobalia*). Found in mangrove swamps and tidal wetlands, West Bengal.
109. Olive Keelback water snake (*Atrretium schistosum*) Found in peninsular India, eastern coastal areas, Uttarakhand, Karnataka, Andhra Pradesh and Tamil Nadu. Reportedly very common around Bangalore.
110. Blyth's Reticulate snake (*Blythia reticulata*). Named after Edward Blyth, Curator of the Asiatic Society of Bengal. Found in Assam, Manipur, Arunachal Pradesh.
111. Sri Lankan Catsnake (*Boiga ceylonensis*). Found in the Western Ghats and Maharashtra.
112. Green Catsnake (*Boiga cyanea*). Found in Sikkim, West Bengal, Assam, Arunachal Pradesh and the Nicobar Islands).
113. Forsten's Catsnake (*Boiga forsteni*). Found in Sikkim and Maharashtra.
114. Many-spotted Catsnake (*Boiga multimaculata*). Found in Assam, Arunachal Pradesh.
115. Orange Catsnake (*Boiga ochracea*). Found in East and Northeast India, Assam, Andaman Islands.
116. Common Catsnake or Indian Gamma Snake (*Boiga trigonata*). Widely distributed in peninsular India, western and eastern Himalayas, Sikkim.
117. Nicobarese Catsnake (*Boiga wallachi*). Found in the Nicobar Islands.
118. Many-banded Tree Snake (*Boiga multifasciata*). Found in Sikkim, western and eastern Himalayas, west Bengal.
119. *Boiga quincunciata*. Found in Assam, Arunachal Pradesh.
120. Gray Catsnake or Eyed Catsnake (*Boiga ocellata*). Found in Arunachal Pradesh.

121. Boiga nuchalis.
122. Arrowback Tree Snake (*Boiga gokool*). Found in Assam, West Bengal, Sikkim, Arunachal Pradesh.
123. Pirmad Catsnake (*Boiga dightoni*). Found in the Western Ghats. It is named after Pirmedu, a place in Kerala.
124. Mangrove snake (*Boiga dendrophila*). Found in mangrove areas of India.
125. Dog-toothed Catsnake (*Boiga cynodon*). Found in Assam.
126. Beddome's Catsnake (*Boiga beddomei*). Found in Maharashtra, and Western Ghats.
127. Andaman Catsnake (*Boiga andamanensis*). Found in the Andaman Islands.
128. Doria's Green snake (*Cyclophiops doriae*). Found in Assam.
129. Gunther's Bridal snake (*Dryocalamus gracilis*). Found in southern and peninsular India.
130. Common Bridal snake (*Dryocalamus nympha*). Found in southern and western India, Orissa, Western Ghats. The yellow mark on the back of the head suggests a bridal veil, hence the name.
131. *Dinodon septentrionalis*. Found in West Bengal and Assam. The word *Dinodon* is Greek for terrible teeth.
132. *Dinodon gammiei*. Found in Sikkim, West Bengal.
133. Indian Egg-eating snake or Westermann's snake (*Elachistodon westermanni*). Found in Maharashtra, West Bengal, Bihar.
134. Yellow-striped Trinket snake or Black Copper Ratsnake (*Elaphe flavolineata*). Found in the Andaman Islands.
135. Common Trinket snake (*Elaphe helena*). Found in Andhra Pradesh, Maharashtra, Arunachal Pradesh, Uttarakhand, Western Ghats.
136. Himalayan Trinket snake (*Elaphe hodgsonii*). Found in Sikkim, Assam, Kashmir.
137. Mandarin Ratsnake (*Elaphe mandarina*). Found in West Bengal, Sikkim, Assam, Arunachal Pradesh.

138. Black-banded Trinket snake or Red Bamboo snake (*Elaphe porphyracea*).
139. Green Trinket Snake, Green Bush Ratsnake or Green Ratsnake (*Elaphe prasina*). Found in West Bengal, Assam, Arunachal Pradesh.
140. Copperhead Trinket snake or Copperhead Ratsnake (*Elaphe radiata*). Found in Assam, Arunachal Pradesh.
141. Beauty Ratsnake or Striped Trinket snake (*Elaphe taeniura*).
142. *Gonyosoma nicobariensis*. Found in the Nicobar Islands.
143. *Gonyosoma cantoris*. Found in Meghalaya, Assam, Sikkim.
144. *Gonyosoma frenatum*. Found in Assam, Arunachal Pradesh.
145. Red-tailed Trinket snake (*Gonyosoma oxycephalum*). Found in the Andaman Islands.
146. Lesser Stripe-necked snake (*Liopeltis calamaria*). Found in the Western Ghats, Karnataka, Uttar Pradesh, Madhya Pradesh, Orissa.
147. Spotted Whipsnake (*Hemorrhois ravergieri*)
148. Puff-faced Watersnake or Masked Watersnake (*Homalopsis buccata*). Found in North East India.
149. Stripe-necked snake (*Liopeltis frenatus*). Found in Assam, Arunachal Pradesh.
150. Collared Reed snake (*Calamaria pavementata*). Found in Assam.
151. Cantor's Watersnake (*Cantoria violacea*). Found in the Andaman Islands.
152. Himalayan Stripe-necked snake (*Liopeltis rappii*). Found in Sikkim.
153. Stoliczka's Stripe-necked snake (*Liopeltis stoliczkae*). Found in Sikkim, Assam, Arunachal Pradesh.
154. Banded Wolfsnake (*Lycodon fasciatus*). Found in Assam.
155. Yellow-spotted Wolfsnake (*Lycodon flavomaculatus*). Found in the Western Ghats, Maharashtra.
156. Laotian Wolfsnake (*Lycodon laoensis*).

157. Tiwari's Wolfsnake (*Lycodon tiwarii*). Found in the Andaman Islands.
158. Zaw's Wolfsnake (*Lycodon zawi*). Found in North-east India.
159. Common Wolfsnake (*Lycodon aulicus*). Widely distributed in India. Called *Kawadivala* in Hindi.
160. Andamanese Wolfsnake (*Lycodon capucinus*). Found on the Andaman Islands.
161. Yellow-speckled Wolfsnake (*Lycodon jara*). Found in Assam, West Bengal, Orissa, Arunachal Pradesh, Uttar Pradesh, Tamil Nadu.
162. Northern Barred Wolfsnake (*Lycodon striatus*). Found in Maharashtra.
163. Travancore Wolfsnake (*Lycodon travancoricus*). Found in Western and Eastern Ghats, Andhra Pradesh, Tamil Nadu, Madhya Pradesh.
164. Theobald's Kukri Snake (*Oligodon theobaldi*). Found in Assam.
165. Western Kukri Snake (*Oligodon affinis*). Found in the Western Ghats.
166. White-striped Kukri snake (*Oligodon albocinctus*). Found in Assam, Sikkim, Arunachal Pradesh.
167. Banded Kukri snake (*Oligodon arnensis*). Found in Maharashtra.
168. Cantor's Kukri snake (*Oligodon cyclurus*) Assam and Eastern India.
169. Gray's Kukri snake or Bengalese Kukri snake (*Oligodon dorsalis*). Found in Assam.
170. Variegated/Streaked Kukri snake (*Oligodon taeniolatus*). Found in Maharashtra.
171. Black-spotted Kukri snake (*Oligodon venustus*). Common all over India, particularly in the Western Ghats. Called *Kawdi saamp* in Hindi.
172. Nagarkot Kukri snake or Red-bellies Kukri snake (*Oligodon erythrogaster*).

173. Günther's Kukri snake or Black-barred Kukri snake (*Oligodon cinereus*). Found in Assam; Arunachal Pradesh
174. Assam Kukri snake (*Oligodon catenata*).
175. Shorthead Kukri snake (*Oligodon brevicaudas*). Found in the Western Ghats.
176. Abor Hills Kukri snake (*Oligodon melanozonatus*).
177. Nikhil's Kukri snake (*Oligodon nikhili*). Found in southern India.
178. Yellow-striped Kukri snake (*Oligodon woodmasoni*). Found on the Nicobar Islands.
179. Red-striped Kukri snake (*Oligodon erythrorhachis*). Found in Arunachal Pradesh.
180. Walnut Kukri snake (*Oligodon juglandifer*). Found in Northeast India.
181. Bluebelly Kukri snake (*Oligodon melaneus*).
182. Assam snail-eater (*Pareas monticola*). Found in Sikkim, Assam, West Bengal, Arunachal Pradesh.
183. Condanarus Sand snake (*Psammophis condanarus*). Found in northern India.
184. Leith's Sand snake (*Psammophis leithi*). Found in western India, Maharashtra, Rajasthan, Uttar Pradesh, Punjab, Kashmir.
185. *Psammophis schokari*. Found in Northwest India, Rajasthan, Punjab, Kashmir.
186. Long Sand Racer (*Psammophis longifrons*). Found in Maharashtra, Madhya Pradesh.
187. Sindh Longnose Sand snake (*Lytorhynchus paradoxus*). Found in Rajasthan.
188. Common Mock Viper (*Psammodynastes pulverulentus*). Found in Assam, Sikkim, West Bengal, Arunachal Pradesh.
189. *Pseudoxenodon macrops*. Widely distributed.
190. Himalayan Keelback (*Rhabdophis himalayanus*) Sikkim Assam, Arunachal Pradesh.
191. Red-necked Keelback (*Rhabdophis subminiatus*). Found in Sikkim, Arunachal Pradesh, maybe also Assam.

192. Brown Trapezoid snake (*Rhabdops bicolor*). Found in Assam, Meghalaya, Arunachal Pradesh.
193. Günther's Many-tooth snake (*Sibynophis bistrigatus*). Found on the Nicobar Islands.
194. Common Many-tooth snake (*Sibynophis collaris*). Found in Assam, Himachal Pradesh.
195. Cantor's Blackheaded snake (*Sibynophis sagittarius*).
196. Spotted Blackheaded snake (*Sibynophis subpunctatus*). Found in Maharashtra, West Bengal, Madhya Pradesh.
197. Red-spotted Diadem snake or Red-spotted Royal snake (*Spalerosophis arenarius*). Found in Rajasthan.
198. Royal snake (*Spalerosophis diadema*). Found in North and northwest India.
199. Khasi Red snake (*Stoliczkaia khasiensis*). Found in Assam.
200. Blackbelly Worm-eating snake (*Trachischium fuscum*). Found in Assam, Sikkim, Uttar Pradesh.
201. Rosebelly Worm-eating snake (*Trachischium guentheri*). Found in Sikkim, West Bengal.
202. Olive Oriental Slender snake (*Trachischium laeva*). Found in the western Himalayan region.
203. Mountain Worm-eating snake (*Trachischium monticola*). Found in Assam, Meghalaya; Arunachal Pradesh.
204. Yellow-bellied Worm-eating snake (*Trachischium tenuiceps*). Found in West Bengal, Sikkim, Arunachal Pradesh.
205. Perrotet's Mountain snake (*Xylophis perroteti*). Found in the Western Ghats.
206. Günther's Mountain snake (*Xylophis stenorhynchus*). Found in the Western Ghats.
207. Andaman Krait (*Bungarus andamanensis*). Found on the Andaman Islands.
208. Common Indian Krait (*Bungarus caeruleus*). Widely distributed except Kashmir, West Bengal, Assam and below Hyderabad. Called *Karayat* in Hindi.

209. Banded Krait (*Bungarus fasciatus*). Widely distributed in India. Called *Ahiraj* or *Rajsaanp* in Hindi.
210. Sindh Krait (*Bungarus sindanus*). Found in central India, Uttar Pradesh.
211. Northeastern Hill Krait (*Bungarus bungaroides*). Found in Assam, Meghalaya, Sikkim.
212. Lesser Black Krait (*Bungarus lividus*). Found in Assam, West Bengal.
213. Greater Black Krait (*Bungarus niger*). Found in Assam, West Bengal, Sikkim, Arunachal Pradesh. Called *Kala Karayat* in Hindi.
214. Beddome's Coral snake (*Calliophis beddomei*). Found in the Western Ghats.
215. MacClelland's Coral snake (*Calliophis macclellandi*). Found in Assam, Sikkim, West Bengal, Arunachal Pradesh.
216. Slender Coral snake (*Calliophis melanurus*). Found in Maharashtra, Karnataka, Kerala, Tamil Nadu.
217. Black Coral snake (*Calliophis nigrescens*). Found in the Western Ghats, Maharashtra, Kerala.
218. Bibron's Coral snake (*Calliophis bibroni*). Found in the Western Ghats. It was named after French zoologist.
219. Monocled Cobra (*Naja kaouthia*). Found in northeastern India.
220. Spectacled Cobra (*Naja naja*). Widely distributed.
221. Black Cobra (*Naja oxiana*). Found in northwest India, Punjab, Kashmir.
222. Andaman Cobra (*Naja sagittifera*) India (Andamans).
223. King Cobra (*Ophiophagus hannah*). Widely distributed in India. Called *Nagraj* or *Rajnag* in Hindi.
224. Large-headed Seasnake (*Astrotia stokesii*).
225. Yellow-and-black Seasnake (*Atretium schistosum*). Found in peninsular India, Tamil Nadu, Andhra Pradesh. Reportedly common around Bangalore.
226. Olive-Headed Seasnake (*Disteira major*). Found in Indian Ocean.

227. *Disteira nigrocincta*. Found in the Indian Ocean, Bay of Bengal.
228. Wall's Sea Snake (*Disteira walli*). Found in the Indian Ocean.
229. Beaked Seasnake or Hook-nosed Seasnake (*Enhydrina schistosa*). Waters around Indian shores.
230. Faint-Banded Seasnake (*Hydrophis belcheri*). Found in the Indian Ocean. This snake was named after British explorer Sir Edward Belcher.
231. Peters' Seasnake (*Hydrophis bituberculatus*). Found in Indian Ocean.
232. *Hydrophis brooki*. Found in Indian Ocean.
233. Blue Seasnake (*Hydrophis caeruleus*). Found in Indian Ocean, Arabian Sea, Bay of Bengal. Called *Samudra saanp* in Hindi.
234. Annulated Seasnake (*Hydrophis cyanocinctus*). Found in the waters off the west coast of India.
235. Banded Seasnake (*Hydrophis fasciatus*). Found in the waters off the eastern coast of India.
236. Kloss' Seasnake (*Hydrophis klossi*). Found in Indian Ocean.
237. Black-headed Seasnake (*Hydrophis mammillaris*). Found in the waters of the Gulf of Cambay, Arabian Sea, Indian Ocean.
238. Black-banded Seasnake (*Hydrophis nigrocinctus*). Found in the Bay of Bengal.
239. Estuarine Seasnake (*Hydrophis obscurus*). Found in the waters off the east coast of India.
240. Cochin banded Seasnake (*Hydrophis ornatus*). Found in Indian Ocean.
241. Persian Gulf Seasnake (*Hydrophis lapemoides*). Found in the waters off the eastern and the western coasts of India.
242. Yellow Seasnake (*Hydrophis spiralis*). Perhaps the longest species of sea snakes. Found in Indian Ocean.
243. Collared Seasnake (*Hydrophis stricticollis*). Found in the waters off the east coast of India.

244. Jerdon's Seasnake (*Kerilia jerdonii*). Found in Indian Ocean, Bay of Bengal.
245. Bighead Seasnake (*Kolpophis annandalei*). Found in Indian Ocean.
246. Short Seasnake (*Lapemis curtus*). Found in the waters off the west coast of peninsular India.
247. Yellow-lipped Sea Krait (*Laticauda colubrina*). Found in Indian Ocean, Bay of Bengal.
248. Blue-lipped Sea Krait (*Laticauda laticaudata*). Found in Indian Ocean and off the Andaman Islands.
249. Hardwicke's Spine-Bellied Seasnake (*Lapemis hardwickii*). Found in Indian Ocean.
250. Annulated Seasnake *Leioselasma cyanocincta*.
251. Yellow Seasnake *Leioselasma spiralis*.
252. *Microcephalophis cantoris*. Found in Indian Ocean and off the Andaman Islands.
253. Slender Narrow-headed Seasnake (*Microcephalophis gracilis*). Found in Indian Ocean, Bay of Bengal.
254. Yellowbelly Seasnake or Pelagic Seasnake (*Pelamis platura*). Found in Indian Ocean, Bay of Bengal, Off Nicobar Islands.
255. *Thalassophina viperina*. Found in Indian Ocean, Bay of Bengal.
256. Himalayan Pit Viper (*Gloydius himalayanus*). Found in Kashmir, Haryana, Himachal Pradesh, Uttar Pradesh.
257. Blunt-nosed Viper, Lebetine Viper, Levant Viper, Levantine Viper, (*Macrovipera lebetina*). Found occasionally in Kashmir.
258. Russell's Viper (*Daboia* (previously *Vipera*) *russelii*). Widely distributed. Called *Kander* in Hindi.
259. Indian Saw-scaled Viper (*Echis carinatus*). Widely distributed except West Bengal, Kashmir. Called *Afai* in Hindi.
260. Common Hump-nosed Pit Viper (*Hypnale hypnale*). Peninsular India to the Western Ghats.

261. Blotched Pit Viper (*Ovophis monticola*). Assam, West Bengal, Sikkim.
262. Brown Spotted Pit Viper (*Protobothrops mucrosquamatus*). Assam, Arunachal Pradesh and other parts of India.
263. Jerdon's Pit Viper (*Protobothrops jerdonii*). Assam, Arunachal Pradesh and other parts of India.
264. White-lipped Pit Viper (*Trimeresurus albolabris*). Found in Assam, Nicobar Islands.
265. Anderson's Pit Viper (*Trimeresurus andersonii*). Endemic to the Andaman Islands.
266. Bamboo Pit Viper (*Trimeresurus gramineus*). Southern and peninsular India, Maharashtra, Andaman Islands, Nicobar Islands. Called *Haranag* in Hindi.
267. Large-scaled Green Pit Viper (*Trimeresurus macrolepis*). Found in the hills of southern India.
268. Malabar rock Pit Viper (*Trimeresurus malabaricus*). Found in the Western Ghats.
269. Chinese Green Tree Viper or Stejneger's Bamboo Pit Viper (*Trimeresurus stejnegeri*). Found in Assam, West Bengal, Meghalaya and eastern Himalayas.
270. *Trimeresurus purpureomaculatus*. Found in Assam and on the Andaman Islands.
271. Pope's Pit Viper (*Trimeresurus popeorum*). Found in Assam, Meghalaya and northeastern parts of India.
272. Medo Pit Viper (*Trimeresurus medoensis*). Found in eastern India.
273. Nicobar Bamboo Pit Viper (*Trimeresurus labialis*). Endemic to the Nicobar Islands.
274. Redtail Bamboo Pit Viper (*Trimeresurus erythrurus*). Found in Assam, Sikkim, Ganges delta.
275. Cantor's Pit Viper (*Trimeresurus cantori*). Endemic to the Nicobar Islands. The snake was named after Theodore E. Cantor a Danish naturalist serving as a surgeon with the East India Company.

*References for the List of Snakes

This list has been compiled from the sources given below. Though every attempt has been made it is by no means, an exhaustive list of all the snake species of India.

1. <http://zipcodezoo.com/search.asp>
2. http://en.wikipedia.org/wiki/List_of_reptiles_of_South_Asia
3. <http://www.taxonomy.nl/Taxonomicon/TaxonTree.asp>
4. <http://www.bio.utexas.edu/grad/sp/pubs/Indian%20Snakes-Checklist.pdf>
5. Snakes of India, P.J Deoras, National Book Trust (reprinted 2006).

Further reading

1. Snakes: The New Book of Popular Science. Vol. 4, Grolier Incorporated (1987).
2. Snakes: New Encyclopedia of Science. Vol. 13, Purnell Reference Books (1979).
3. Grzimek's Animal life Encyclopedia. Vol.13 (Reptiles) Thomson-Gale (2003).
4. Snake: World Book Encyclopedia. Vol-S, World Book Inc.
5. Snakes of India, P.J Deoras, National Book Trust (reprinted 2006).
6. Wildlife Encyclopedia, Funk and Wagnell. Vols 1-22, B. P. C. Publishing Ltd. (1974).
7. Snake envenomation in a North Indian hospital. Sharma, S Chauhan, S Faruqi, P Bhat and S Varma., Emerg. Med. J. 2005; 22:118-120.
8. Snake venom habituation in heroin (brown sugar) addiction: (report of two cases). Pradhan PV, Shah LP, Ghodke PR, Nayak, PRJ Postgrad Med [serial online] 1990 [cited 2006 Nov 14]; 36:233-4).
9. <http://www.wildrockies.org/WildCPR/reports/ECO-EFFECTS-ROADS.html>

Glossary

Antibodies: A group of specific proteins that are produced by the body to defend itself against foreign organisms.

Antigen: A foreign molecular entity, which induces the production of specific antibodies against it.

Biodiversity: The sum total of all the variety of life present on Earth.

Endemic: Restricted to a certain region.

Enzymes: Complex protein molecules that initiate, accelerate, or sometimes even retard biochemical reactions in the body without themselves changing.

Exotic: Not endemic to an area. Not occurring naturally in an area; introduced species.

Food Chain: A sequence of organisms in which each is food of a later member of the sequence.

Genes: Basic units of heredity.

Geological Time Period: The period of time covering the formation and development of the Earth.

Gills: Filamentous respiratory organs of aquatic animals.

Immunity: An in-built defense mechanism of the body that allows it to resist infection etc.

Ligaments: Fibrous tissue that binds bones together.

Mimic: To assume, usually for protection, the habits, colour, or structure of another organism.

Tendons: Thick, inelastic tissue that attaches a muscle to a bone.

Ulcer: A sore on the skin accompanied by the disintegration of tissue.

Vaccination: Process of providing protection against an infectious disease.

Index

A

Aestivation, 54
 Allergen, 20
 Alligator, 46
 Amphibians, 7
 Anaconda, 31
 Anal spurs, 55
 Anti-venom, 19
 Antibodies, 20
 Aquatic snakes, 31

B

Binomial system, 6
 Biodiversity, 5
 Biological evolution, 2
 Biologists, 59
 Bird populations, 63
 Brille, 32
 Brown snakes, 41
 Burrowing snakes, 31

C

Cannabis, 26
 Caterpillar, 38
 Chin shields, 32
 Chromatophores, 32
 Cobra, 4, 16
 Cobras, 4, 9
 Cold-blooded, 7
 Cottonmouths, 44
 Cretaceous period, 54

D

Defensive behaviour, 28
 Deforestation, 59
 Deserts, 28
 Digestive glands, 48
 Dry-bites, 12

E

Earth-tones, 32
 Ecological, 60
 Ecologists, 27
 Ecosystem, 64
 Ectotherms, 7
 Eggs, 28, 41, 52
 Eggshell, 12, 41
 Elastic Jaws, 45
 Endocrine disorders, 64
 Environment, 4
 Enzymes, 11
 Ephemeral, 62
 Erectile teeth, 11
 Exotic species, 30
 External, 37

F

Fangs, 10
 Flexible, 46
 Flying" Snakes, 68
 Food chains, 60
 Fossil, 29, 54

Foxes, 56

G

Gall bladder, 48, 58
 Grasslands, 59
 Grooved fangs, 10

H

Halahal, 4
 Hemo-toxic, 12
 Hemo-toxin, 12
 Herpetologists, 24
 Herpetology, 65, 70
 Hibernation, 54
 Hognose snake, 15, 16
 Hollow fangs, 10

I

Ichchadahari, 21
 Icy wasteland, 29
 Internal fertilization, 51

K

Keratin, 32
 King cobra, 52
 Kingfishers, 56
 Kingsnake, 16

L

Ligaments, 45
 Limbs, 35

M

Madras Crocodile Bank Trust, 65
 Mambas, 17
 Mammal, 25, 48, 63
 Mandrax, 26
 Marshes, 59
 Metabolic rate, 47
 Mimic, 33
 Mineral exploration, 59

Miocene age, 29
 Muscle tissue, 36

N

Naag mani, 22
 Nag Panchami, 4, 25
 Nature's creatures, 5
 Nausea, 17
 Neanderthal man, 2
 Neck muscles, 46
 Nest predators, 61
 Neuro-toxic, 12
 Nomenclature, 6
 Nutrient transport, 47

O

Oceans, 28
 Ophiophagus, 55
 Oral cavity, 49
 Ovoviviparous, 51

P

Parachute, 39
 Paralysis, 10, 17
 Parrot snake, 16
 Pericardium, 49
 Pesticide poisoning, 63
 Phyla, 5, 8
 Phylum Vertebrata, 6
 Polar oceans, 7
 Polar regions, 29
 Ponds, 28
 Predators, 16
 Prey, 12, 18, 42, 46
 Proteins, 11
 Public events, 64
 Python, 3, 46
 Pythons, 42, 45, 47, 51, 58

Q

Quetzalcoatl, 4

R

Raccoons, 56
 Rain Powers, 4
 Rainforests, 59
 Rattlesnake, 43, 51, 57, 64
 Red Indians, 4
 Reptiles, 6, 7, 56
 Respiratory system, 49
 Rodent, 65

S

Saltation, 39
 Sandy deserts, 59
 Scales, 32
 Sea snakes, 67
 Shesh Nag, 4
 Sigmund Freud, 1
 Slithering, 38
 Snake charmer, 69
 Snake eater, 57
 Snake skeletons, 35
 Snake territory, 13–14
 Snake-dens, 26
 Species, 5, 8
 Spectacle, 32
 Spitting Cobra, 68
 Sports jackets, 59

T

Tastebuds, 38
 Termite, 41

Territory, 28
 Thin-shelled eggs, 64
 Toxic saliva, 12
 Traditional methods, 69
 Tree snake, 29
 Tropical countries, 14

U

Ureters, 50

V

Vaccination, 20
 Vacuum, 5
 Vasuki, 4
 Venom, 4, 9, 12, 59
 Venomous snake, 11
 Vertebra, 35
 Viper, 32, 47
 Vomeronasal organ, 37

W

Warm climates, 34
 Waste products, 50
 Weasels, 56
 Wetlands, 62
 Woodlands, 59
 World Wide Fund, 65

Z

Zoology, 27